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TAYLOR (G. G.). **Spray Injury from Use of Lead Arsenate on Apple Trees.**—*N.Z. J. Sci. Tech.* (A) **32** no. 6 pp. 39–48, 2 figs., 8 refs. Wellington, N.Z., 1951.

The following is substantially the author's summary. The occurrence on apple trees of fruit and foliage injury resulting from the use of sprays containing lead arsenate is discussed. Evidence from field trials in New Zealand shows that lead arsenate mixed in artesian water (temporary hardness 7·0 grains per gallon) can cause severe foliage injury and slight to moderate fruit injury on apple trees of the Sturmer variety in the Hawkes Bay district. Addition of 3 lb. hydrated lime to 100 gals. spray containing 1½ lb. lead arsenate reduces, but does not prevent, foliage damage. When lime-sulphur plus colloidal sulphur is combined with lead arsenate plus hydrated lime, injury is negligible. If colloidal sulphur is omitted from the complete mixture, foliage damage becomes very severe. Increase in concentration of lime-sulphur increases the severity of leaf damage. Fruit injury increases with leaf damage, but not in the same proportion. Addition of Agral 2, a proprietary wetting agent containing alkylated naphthalene sulphonates, to lead arsenate plus lime-sulphur and colloidal sulphur causes a characteristic type of injury on fruit. Inclusion of hydrated lime in the mixture reduces the severity of injury, which then shows as fruit russet. From comparison of the above results with laboratory analyses of spray mixtures containing lead arsenate, it is concluded that development of arsenic damage on trees is not directly correlated with occurrence of soluble arsenic compounds in spray mixtures. Chemical reactions in spray residues on trees are of major importance in causing arsenic injury.

WILSON (H. B.). **The Argentine Ant. D.D.T. shows Promise in Control Experiments.** —*J. Dep. Agric. Vict.* **49** pt. 5 pp. 217–219, 1 fig., 1 ref. Melbourne, 1951.

Following the recommendation of a sodium-arsenite bait against *Iridomyrmex humilis* (Mayr) in Melbourne, Victoria [*R.A.E.*, A **28** 443], attempts were made to discover a less hazardous means for control of this ant. Baits containing 0·1 per cent. DDT as a finely divided suspension prepared by precipitating the DDT from alcoholic solution into a mixture of honey and water or as an emulsified solution in the honey mixture were readily taken by the ants, but were too unstable to be of practical value. In the summer of 1947–48, a heavy infestation in a hospital was greatly reduced by spraying the outside walls, concrete paths, and tree trunks with an emulsified solution of 5 per cent. DDT. In 1949–50, an emulsified solution of 0·5 per cent. DDT, applied on two successive days to the outside brick walls of a house and to concrete paths and adjacent areas where the ants were numerous gave almost complete control in a few days, and the treatment was then applied to other houses in the vicinity and repeated after two weeks ; two months later, only three ants were found, all showing symptoms of DDT poisoning, and after a further two months, none was seen. In another test, an emulsified solution of 0·25 per cent. DDT applied in a band 3 ft. wide to the base of the outside walls of houses and to paths, rockeries, tree trunks, fence rails and nests and trails of the ants caused the latter to disappear almost immediately and there was no sign of an increase over a period of several months. A reduction of the DDT concentration to 0·1 per cent. proved unsatisfactory.

The effective treatments controlled the ants within the houses as well as outside, except where the nests were in the foundations or beneath floors. In a house in which infestation persisted in spite of outside treatment, a commercial preparation stated to contain 4–5 per cent. DDT and pyrethrum applied with a cloth pad to skirting boards and tiled walls in horizontal bands 6 ins.

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wide and as a spray to a kitchen cupboard caused the ants to disappear in a few weeks. Outside surfaces of brick and concrete sprayed with DDT remained toxic for at least two months, even though exposed to heavy rain. On the basis of these tests, an emulsified solution of 0·25 per cent. DDT applied evenly during fine weather in a continuous band to the foundations of buildings, concrete paths, the trunks of trees and shrubs, and other continuous surfaces over which the ants run is recommended. One thorough treatment is normally sufficient, and it is desirable at the same time to treat surfaces over which the ants pass to enter the building with a concentration of at least 0·5 per cent. DDT. One complete application in early summer followed by two others at intervals of about two months is required.

Pasfield (G.) & Braithwaite (B. M.). **The Argentine Ant** (*Iridomyrmex humilis* **Mayr**) **recorded from New South Wales.**—*Agric. Gaz. N.S.W.* **61** pt. 7 pp. 335–340, 1 fig., 1 map, 9 refs. Sydney, 1950.

Ants received from three places within the metropolitan area of Sydney, New South Wales, in April, May and June 1950 were identified as *Iridomyrmex humilis* (Mayr), which had previously been recorded in Australia only from Victoria [*cf. R.A.E.*, A **30** 153] and Western Australia [*cf.* **32** 227]. The ants had first been noticed at Sydney three years earlier, since when they had greatly increased in numbers. The infested areas are defined, and accounts are given of the bionomics and economic importance of *I. humilis* and of the control measures employed against it elsewhere. Notes on chlorinated insecticides that are of value against various ants are included [see preceding abstract].

Lloyd (N. C.). **Hilling to control Potato Moth in Tableland Potato Crops.**—*Agric. Gaz. N.S.W.* **61** pt. 8 pp. 409–414, 2 figs., 4 refs. Sydney, 1950.

Injury to potato crops by *Gnorimoschema operculella* (Zell.) on the tablelands of New South Wales can be considerably lessened by the adoption of a rotation including subterranean clover [*Trifolium subterraneum*], which, by providing organic matter, reduces the tendency of the soil to crack and so to expose the tubers to infestation. Hilling the soil round the plants by means of a tractor fitted with disks gave satisfactory results in earlier experiments [*R.A.E.*, A **35** 316], and further tests were accordingly made in 1947–49.

In 1947, treatment carried out by means of the disk equipment, or a horse-hoe with hilling plates attached, 108 days after planting in crop rows spaced 3 ft. apart reduced the percentage (by weight) of infested tubers from 18·4 to 2·3 and 4·4, respectively. The treatments checked the growth of the plants, however, and fewer tubers of marketable size were produced ; in consequence, the total yields were reduced by about 12 and 8 per cent., and the yields of undamaged tubers were little above that for no treatment. In another test in which the crop rows were only 2½ ft. apart, the percentage infestation was reduced from 27·8 to 10·8 by the disk equipment and to 17·7 by the horse-hoe, but both methods reduced the total yield by 5–6 per cent., though the disk equipment gave a fair increase in yield of uninfested tubers. The horse-hoe operated more and the tractor less efficiently with the narrow spacing. Infestation was very light in 1948, and though the treatments caused a reduction in two tests, the total yield was again reduced, with little increase in yield of uninfested tubers, and, as in the previous year, it was necessary to take the horse-hoe over the ground twice to obtain the desired effect. Weather conditions favoured *G. operculella* during the late summer and autumn of 1949, but the soil on which the tests were carried out had been under subterranean clover for several years and losses were not heavy. Treatment by means of the disk equipment on crop rows spaced about 3 ft. apart 113 days after planting

reduced infestation from 18·77 to 5 per cent., considerably reduced the percentage of tubers that became green through exposure, and hence unmarketable, and did not affect the total yield, but in another test, the total yield was reduced by about 11 per cent., although there was a marked reduction in infestation as a result of treatment, and there was some reduction in yield of uninfested tubers. It is concluded that hilling is of value in seasons in which *G. operculella* is sufficiently numerous to become injurious if dry weather should favour its further increase and cause the soil to crack ; this can usually be determined early in March.

NORRIS (K. R.). **The aestivating Eggs of the Red-legged Earth Mite,** *Halotydeus destructor* **(Tucker).**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 253, 26 pp., 2 figs., 12 refs. Melbourne, 1950.

The aestivating eggs of *Halotydeus destructor* (Tucker) [*cf. R.A.E.*, A **29** 142], which are described, differ from the winter eggs in that they are larger, have thicker chorions, are usually asymmetrical and are retained inside the body of the mite, which serves as a protective envelope after death, whereas winter eggs are laid on plants. In studies in Western Australia, about 20 per cent. of two batches of aestivating eggs produced in the field in October 1937 and taken to the laboratory later in that summer, were still viable in July 1941 ; a high percentage of aestivating eggs within dead mites survived desiccation over concentrated sulphuric acid for four months, whereas winter eggs all died after 16 hours. At 11°C. [51·8°F.], the mean developmental period of normally weathered aestivating eggs was 20·6 days ; data obtained by other investigators [**32** 166] indicate that winter eggs would require about 11·5 days for development at that temperature. At room temperatures averaging 11·3°C. [52·34°F.], winter eggs developed in 7·5–17·5 days, with a mean of 11·3, and aestivating eggs in 14·5–55·5, with a mean of 15·5. The mean numbers of eggs found per fertile mite in pastures during May–November in 1938–41 are shown on a graph. In each year, a maximum was reached in the first part of October, and in 1939, when rains delayed the drying up of the pastures, there was a second peak in November. Winter eggs are produced until a few weeks before the pastures dry up in October, and when mites were collected at weekly intervals from 4th September until 16th October, after which no more were present, and killed by starvation and desiccation it was found that most of the aestivating eggs were matured between mid-September and early October and that few of the eggs in mites collected during the last week of the season were viable.

Aestivating eggs must be moistened before they can develop, but when this was done at a temperature too high for development to proceed, they absorbed water and remained viable for as long as six weeks without any appreciable reduction in viability. When eggs were stored for five months at room temperature (with a mean of 12°C. [53·6°F.]) and various relative humidities between 0 and 86 per cent., very low humidities caused high mortality, and room humidity seemed the most favourable ; it is concluded that only prolonged exposure to very low humidities can seriously affect viability. Exposing the dead mites to sunlight for three months did not destroy all the eggs. Soil temperatures of the order of 64·5°C. [148·1°F.] are probably common while aestivating eggs are present, and temperatures below the threshold for development are unlikely to occur ; moistened eggs were able to survive exposure to temperatures between 0 and −7·7°C. [32 and 18·14°F.] for seven days. Although the parent mites shelter from the heat and dryness before dying and grazing sheep remove much of the vegetation from pastures and disturb the soil during the summer, experiments showed that removal of all vegetation early in the summer does not destroy many of the eggs, and that although exposure to

sunlight for several months causes high mortality, a covering of soil only $\frac{1}{8}$-in. thick provides adequate protection.

The existence of males of *H. destructor* has not been demonstrated, and mating has not been observed ; in the present study, five mites reared from the egg in isolation did not oviposit or spin webs, which is a supposedly male characteristic [**26** 151], though they were provided with adequate food and some survived for as long as six weeks. Although contact with free moisture is necessary to initiate development of the aestivating eggs, the amount of water present is of little importance, and even submerged eggs can hatch. After the chorion has split and while the protruding part of the embryo is still enclosed in a membrane (deutovum stage), the embryos require less moisture and can be poisoned by toxic materials dissolved in it, which do not affect them in the earlier stage. Eggs hatched at a temperature fluctuating between 8·5 and 0·5°C. [47·3–32·9°F.], and a greater proportion at 11°C., though the mean incubation period was considerably longer at that temperature than at fluctuating temperatures with an average of about 11°C. ; a few hatched at an average of 22·4°C. [72·32°F.], and none in 43 days at 24·6°C. [76·28°F.], though the eggs remained viable. The incubation period of eggs that had been moistened at summer room temperatures and later transferred to winter room temperatures and again moistened was very short. The peak temperature [**31** 421] was below 15°C. [59°F.] but the effect of temperature on the duration of the deutovum stage, which decreased with increasing temperature over the range at which hatching occurred, appeared to be independent of that on the total incubation period. When dry eggs were stored under different moisture conditions, those exposed to 34 per cent. relative humidity developed the most quickly. The percentage hatch from eggs collected in November was lower than that from eggs collected from the same place in April, and there is evidently a short diapause, possibly preventing premature hatching if cool, moist weather conditions should return. The development of the aestivating eggs is possibly affected by the food of the parents since mites from vegetable gardens are usually larger and more brightly coloured and contain more eggs than those from pastures, and the eggs themselves are a deeper colour.

Simmons (P.), Fisher (C. K.) & Tyler (J. G.). **Notes on the Apache Wasp in California.**—*Ann. ent. Soc. Amer.* **41** (1948) no. 4 pp. 450–454, 6 figs. Columbus, Ohio, 1949.

Persons harvesting figs in the vicinity of Fresno, California, are frequently stung by *Polistes apachus* Sauss., a wasp that builds its nests in the fig trees. Injury is commonest in September and October, when the trees are shaken or jarred to dislodge the figs, the wasp colonies are large, and the insects are active and aggressive if disturbed, because day temperatures are high. Observations showed that construction of the nests was begun, probably by fertilised overwintered females, when the leaves of Calimyrna fig trees were 1–2 ins. long. Most nests were attached to small branches at the tops of low trees, but they also occurred on large branches, sometimes within 4–5 ft. of the ground, and have been found on green figs, on a leaf petiole and inside the paper bags that are fastened to the trees for holding caprifigs. Oviposition began when 2–3 cells had been made. Eggs were first observed at about the middle of April, and larvae appeared about 14 days later and began to cap the cells after a fortnight. The adults flew round the trees when the weather was warm but were inactive when it was moderately cool. Some collected in early July lived for about 75 days when honey and water were provided. Examples of the Ichneumonid parasite, *Polistiphaga fulva* (Cress.), emerged from a nest collected on a building in Fresno, and damage to combs, probably by birds, was observed. In the

orchard in which most observations were made, nests were most plentiful along the north and east sides, near an irrigation ditch.

Attempts to attract the adults with baits of beef liver, honey or sweet ant poisons in spring before nest-building began were unsuccessful, and though scorching the nests on the trees killed some of the adults and brood, some of the larvae left in scorched nests were able subsequently to cap their cells. When nests were removed in spring or early summer, fresh ones were built in the same tree, often within a week ; when they were removed in September, the adults returned to the site but did not rebuild. Liberal applications of 10 per cent. DDT dust were made to nine nests on 22nd August, 1947, and six were free of adults four days later. Emergence from capped cells continued, but the newly emerged wasps died within a few days.

SMITH (A. H.) & DOUGLAS (J. R.). **An Insect Respirometer.**—*Ann. ent. Soc. Amer.* **42** no. 1 pp. 14–18, 1 fig., 7 refs. Columbus, Ohio, 1949.

A detailed description is given of the construction and use of an apparatus for measuring the oxygen consumption of insects of about the size of the house-fly [*Musca domestica* L.], by noting the position of an index oil droplet in a calibrated capillary that communicates with a sealed chamber containing the insect. The results of a trial made with house-fly larvae are given as an example.

SLIFER (E. H.). **Variations, during Development, in the Resistance of the Grasshopper Egg to a toxic Substance.**—*Ann. ent. Soc. Amer.* **42** no. 2 pp. 134–140, 2 graphs, 11 refs. Columbus, Ohio, 1949.

The following is virtually the author's summary. The primary wax layer on the inner surface of the chorion of the egg of *Melanoplus differentialis* (Thos.) acts as a barrier to the passage of iodine (dissolved in a solution of potassium iodide) during the first five days after the eggs are laid. However, traces of iodine or potassium iodide probably do penetrate the wax layer, for development stops in these eggs even though no effect on the yolk can be seen. From the fifth to about the sixteenth day at 25°C. [77°F.] the eggs are highly susceptible to iodine poisoning, and the newly-formed hydropyle [*cf. R.A.E.*, A **33** 386] is discoloured by this substance as it passes through it into the yolk and kills the embryo. During diapause, the hydropyle, now protected by the secondary wax layer, is not stained or penetrated by iodine, and the eggs are entirely unharmed even after long exposure to this reagent. When diapause is over, the hydropyle again stains readily in a solution of iodine and the iodine passes through it, darkens and coagulates the yolk and kills the embryo.

There is a close correlation between the permeability of the hydropyle to water, the presence of a layer of wax or wax-like material and the susceptibility of the eggs to injury by iodine. A knowledge of the periods when the eggs are least resistant to a toxic agent may be of some value to those who are interested in the control of grasshoppers.

MACCREARY (D.) & RICE (P. L.). **Parasites of the European Corn Borer in Delaware.**—*Ann. ent. Soc. Amer.* **42** no. 2 pp. 141–153, 5 figs. Columbus, Ohio, 1949.

The following is largely based on the authors' summary. *Pyrausta nubilalis* (Hb.), which was first found in Delaware in 1934 [*cf. R.A.E.*, A **26** 545], has become the most important pest of maize there, and attempts to control it by liberating insect parasites were begun in 1941. Over 97,000 individuals of *Macrocentrus gifuensis* Ashm., *Eulophus viridulus* Thoms., *Angitia* (*Horogenes*) *punctoria* Rom., *Lydella stabulans grisescens* R.-D., and *Chelonus annulipes*

Wesm., nearly 82,000 being *M. gifuensis*, were liberated during 1941–46, and information on the extent of parasitism was obtained by collecting full-grown larvae of *P. nubilalis* in the autumn and early winter near the release points in 1943–46 and at 30 places selected to cover the entire State in 1947. Additional collections were made in special study-areas established about two of the release sites to secure data on parasite dispersal.

Three parasites were found to have become established, *M. gifuensis* in three localities, at one of which it gives important control, *C. annulipes* in one and *L. s. grisescens* throughout the State. The last appears to have considerable value in reducing the numbers of overwintering larvae and to have spread outwards in all directions from the points of liberation. In two localities the average rates of parasitism by it increased from 2·7 and 9·95 per cent. in 1943 to 19·8 and 28·7 per cent. in 1946, respectively, and two of the collections at the second showed 56 and 61·5 per cent. parasitism in 1946. In 1947, *L. s. grisescens* was shown to be present at all but one of the collection sites and parasitised about 11·5 per cent. of the borers in each of the three counties. It did not itself appear to be parasitised.

Three indigenous parasites of *P. nubilalis*, *Agathis* (*Bassus*) *agilis* (Cress.), *Cremastus minor* Cushm., and *Pyraustomyia penitalis* (Coq.), were reared in various years, but in insignificant numbers.

JOHANSEN (C.). *Meteorus argyrotaeniae*, **a new Species of Braconidae parasitic on the Orange Tortrix.**—*Ann. ent. Soc. Amer.* **42** no. 3 pp. 319–320. Columbus, Ohio, 1949.

The adult female of *Meteorus argyrotaeniae*, sp.n., is described from examples reared from cocoons found in the tied-leaf nests of the larvae of *Tortrix* (*Argyrotaenia*) *citrana* Fern. on red raspberry at Puyallup, Washington, in 1948 [*cf. R.A.E.*, A **38** 360] and from cocoons and host larvae from the nests of an unidentified leaf-roller on plane [*Platanus*] at Vancouver, British Columbia, in the same year. Characters are given distinguishing it from two closely related species. Pupae were first observed in the nests on raspberry in mid-April. The degree of parasitism had increased to 15–50 per cent. in some fields by the last week of July, and the Braconid showed evidence of giving partial control of *T. citrana* in certain fields during the picking season.

KOBLITSKY (L.) & CHISHOLM (R. D.). **Determination of DDT in Soils.**—*J. Ass. off. agric. Chem.* **32** no. 4 pp. 781–786, 1 fig., 11 refs. Washington, D.C., 1949.

In one of the procedures authorised in the United States as a basis for certification of plants to be moved from areas regulated by the quarantine against the Japanese beetle [*Popillia japonica* Newm.], DDT is applied at the rate of 25 lb. per acre and cultivated into the soil to a depth of 3 ins. [*R.A.E.*, A **37** 106]. Retreatment is necessary when analyses of soil samples taken from treated areas indicate a loss of DDT content, and the authors describe a fairly rapid method of determining DDT in soil, based on the removal of the total organic chlorine from an extract by metallic sodium in the presence of isopropyl alcohol [*cf.* **38** 382].

The average recoveries from sandy loam, clay soil and muck soil treated with DDT at a rate equivalent to 25 lb. per acre to a depth of 3 ins. were 24, 23 and 23·5 lb., respectively, when comparisons were made with untreated soil and 25, 24 and 27 lb. when they were not, the variation between soils being least when they were analysed in a nearly air-dry condition. The differences between recoveries from duplicate subsamples were 0–2·5 lb. per three-inch acre.

Marshall (D. S.) & Gyrisco (G. G.). **Control of the Meadow Spittlebug on Forage Crops.**—*J. econ. Ent.* **44** no. 3 pp. 289–293. Menasha, Wis., 1951.

Preliminary tests were carried out in June and July 1948 of sprays, thermal aerosols and dusts for the control of *Philaenus leucophthalmus* (L.) on lucerne or red clover in New York. In sprays, BHC (benzene hexachloride) at 2 lb. γ isomer per acre gave complete control of the nymphs three weeks after application, whereas chlordan and DDT at 2 lb. per acre did not. Aerosols released from solutions of 1 per cent. BHC or dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] with particle diameters of 60 microns gave complete control of nymphs on lucerne in 48 hours, but 1 per cent. aerosols of toxaphene or aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] were much less effective. In dusts, BHC at 1 lb. γ isomer per acre and chlordan and DDD (TDE) [dichlorodiphenyldichloroethane] at 2·25 lb. gave complete immediate control of the adults on clover in its first crop year, but DDT at 2·25 lb. per acre was less effective and no material was satisfactory after three weeks.

In tests with dusts in 1949, BHC applied to first-year clover on 12th May at 0·5 lb. γ isomer per acre, dieldrin, aldrin and chlordan at 2 lb. per acre, and toxaphene and methoxy-DDT (methoxychlor) at 4 lb. per acre all gave very good control of the nymphs, whereas parathion at 1·25 lb. per acre did not. In impregnated dusts applied against the nymphs on 26th May, BHC at 1 lb. γ isomer per acre was more effective than 1 lb. chlordan or DDT, and parathion at 1 lb. was ineffective, and when proprietary dusts were applied on 24th May, BHC at 1 lb. γ isomer per acre gave complete control and was more effective than methoxy-DDT and dieldrin at 10 and 2·5 lb. per acre, respectively, while toxaphene at 10 lb., chlordan at 5 lb., parathion at 2 lb. and aldrin at 2·5 lb. gave good results but were less effective. It was concluded that control measures were best applied against the nymphs and that BHC and dieldrin were the most effective of the compounds used.

In 1950, single applications of 1 lb. lindane [at least 99 per cent. γ BHC] per acre in dusts were made on a series of plots in a field of clover on 18th April or 1–5 weeks later. The first froth mass was observed on 9th May, and counts made two weeks after the last treatment date showed that the earliest effective treatment was that made one week before the nymphs hatched, while applications made 1–2 weeks after hatching were also very effective. As the risk of residues on the hay at harvest is greatest from late applications, and as the nymphs are least resistant to insecticides soon after they hatch, treatment should be applied as near to the earliest appearance of the nymphs as possible. Applications of various toxicants at 0·1–0·3 lb. per acre in sprays throughout the nymphal period in 1950 showed that BHC was the most effective of them, though it was equalled by dieldrin at the higher rates ; toxaphene, purified DDT and heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] were slightly less effective, and technical DDT and a mixture of 2-nitro-1,1-bis(p-chlorophenyl)propane and 2-nitro-1,1-bis(p-chlorophenyl)-butane (1 : 2) were the least satisfactory, though giving fair control at the higher rates. In further tests with BHC, effectiveness decreased as the age of the nymphs increased, and it appeared that at least 0·3 lb. γ isomer per acre should be applied in sprays and at least twice as much in dusts to secure high control of nymphs in all instars.

Sloan (M. J.) & Rawlins (W. A.). **Field Trials in Onion Thrips Control.**—*J. econ. Ent.* **44** no. 3 pp. 294–301, 15 refs. Menasha, Wis., 1951.

During the summer of 1949, when there was a drought over most of New York State, the high temperatures and low rainfall favoured an increase of

Thrips tabaci Lind. on onion. As early reports from growers indicated that DDT was not giving satisfactory control unless applied at very short intervals, several of the newer insecticides were tested on fields of seed onions in Oswego and Wayne counties in 1949 and 1950. Experiments with dusts in 1949 showed that 3 and 5 per cent. heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] and 5 per cent. dieldrin [1,2,3,4,10,10-hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethano - naphthalene] gave high initial kills, and heptachlor maintained more than 50 per cent. reduction in thrips population for ten days. Dusts of 5 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethano-naphthalene] or 1 per cent. parathion gave more than 75 per cent. reduction two days after application, but these and 3 per cent. chlordan, 5 per cent. DDT and 1 per cent. lindane [at least 99 per cent. γ benzene hexachloride] were only slightly effective after 7–10 days. When applied in wettable-powder sprays, chlordan, aldrin, dieldrin and heptachlor at 2 lb. per acre and parathion at 0·3 lb. per acre gave 90 per cent. or more reduction after two days, and dieldrin and heptachlor were as effective after nine days. DDT at 2 lb. per acre in a wettable powder and lindane and DDT at 0·5 lb. in a wettable powder and an emulsion, respectively, were less effective. When applied as wettable-powder sprays, chlordan and DDT at 2 lb., parathion at 0·15 lb. and aldrin, dieldrin and heptachlor each at 0·5, 1 and 2 lb. per acre all gave more than 70 per cent. reduction in thrips in two days. The reduction was 90 per cent. or more for dieldrin and heptachlor at all three rates and chlordan and aldrin at 2 lb. per acre after two days and for 1 and 2 lb. dieldrin after 13 days, when parathion, chlordan and DDT were ineffective. Comparison of the results of applications of emulsion and wettable-powder sprays of DDT, chlordan, aldrin, dieldrin and heptachlor showed that all gave very significant control after two days, with no significant difference between emulsions and wettable powders.

In 1950, when DDT at 1 lb. and dieldrin at 0·96 lb. per acre were applied in emulsion sprays with ground equipment, dieldrin was 70 per cent. more effective than DDT 10–12 days after treatment, and when applied from an aeroplane, 5 per cent. dieldrin dust was at least 60 per cent. more effective than 5 per cent. DDT dust after ten days and 29 per cent. more effective after 22 days, and a dieldrin emulsion spray was more effective for at least eight days than an emulsion spray containing a similar quantity of DDT with the addition of tetraethyl pyrophosphate. In small-plot spray tests on 19th July, DDT, aldrin and dieldrin in emulsions at 1, 0·92 and 0·96 lb. per acre, respectively, and parathion and ethyl p-nitrophenyl thionobenzenephosphonate in wettable powders at 0·075 and 0·135 lb. per acre all gave significant control for eight days, but aldrin and dieldrin were significantly better than the other materials after 15 days ; and in others on 5th August, 2 lb. DDT, 0·45 lb. parathion, 1 lb. dieldrin, heptachlor or schradan (bis-dimethylamino-phosphonous anhydride) and 0·27 lb. ethyl p-nitrophenyl thionobenzenephosphonate gave good control for 3–7 days, with dieldrin and heptachlor the most effective after 16 days.

Lienk (S. E.) & Chapman (P. J.). **Orchard Mite Studies in 1950.**—*J. econ. Ent.* **44** no. 3 pp. 301–306, 1 graph, 3 refs. Menasha, Wis., 1951.

Further investigations made in 1950 on the status of the four Tetranychid mites known to occur in orchards in New York confirmed the results previously obtained [*R.A.E.*, A **39** 12] and revealed minor infestations of *Septanychus canadensis* McGregor [**39** 102], which is the mite previously recorded as a species of *Septanychus* [**39** 12], on apple, sometimes in association with *Tetranychus*

bimaculatus Harvey or *Paratetranychus pilosus* (C. & F.) or both ; the distribution and economic importance of this mite are almost certainly greater than the records indicate. *Bryobia praetiosa* Koch is prevalent throughout the State and numerous in unsprayed orchards, and has been reported to attain economic numbers even in well-kept orchards. Detailed studies showed that the general rate of development is similar for *T. bimaculatus*, *P. pilosus* and *S. canadensis*, with approximately eight generations in the year, while *B. praetiosa* develops more slowly and has only five. This species, unlike the others, spends as much time on the spur wood and twigs as on the leaves. Only parthenogenetic reproduction was observed.

In ovicidal spray tests [*cf.* **39** 12], 0·25–0·75 per cent. of a preparation (DN-289) containing 21·5 per cent. dinitro-o-sec.-butylphenol [as the triethanolamine salt] proved inferior to 2 per cent. petroleum oil in killing winter eggs of *P. pilosus* on apple and allowed more rapid subsequent increase in mite populations, even when used at twice the normal rate of about 12 U.S. gals. per tree. Applications of 8 fl. oz. 20 per cent. TEPP (tetraethyl pyrophosphate), 1 U.S. gal. petroleum oil or 1·5 lb. 50 per cent. p-chlorophenyl p-chlorobenzenesulphonate per 100 U.S. gals. in late May, just before or after the beginning of flowering, gave good control early in the season and were superior to the dormant sprays.

In tests in an orchard heavily infested with *P. pilosus* in which various sprays were applied on 9th July, seven organic phosphorus compounds all gave good initial kill, and all but two gave good control for 16 days ; ethyl p-nitrophenyl thionobenzenephosphonate had the best prolonged action. Definite ovicidal action, probably limited to the older eggs, was shown by this compound, parathion and S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate, but by no others. The systemic material, schradan (bis(bis-dimethylamino)phosphonous anhydride), gave good immediate control and fair results after 16 days, but showed no evidence of systemic action against the mite, though there was apparent systemic action against *Aphis pomi* Deg. seven weeks after treatment. Control by p-chlorophenyl p-chlorobenzenesulphonate was the poorest of all initially, but very high after 10–16 days.

Similar results were obtained with most of the materials against *T. bimaculatus*, except that some failed to give protection after 10–12 days, making a second treatment necessary ; p-chlorophenyl p-chlorobenzenesulphonate was the only material that gave nearly complete control after a month, though its initial toxicity was again low.

In preliminary tests, in which schradan and another systemic material, a trialkyl thiophosphate, were applied in sprays to the ground cover in an infested orchard in which the trees had been sprayed with ethyl p-nitrophenyl thionobenzenephosphonate, both gave promising control of *T. bimaculatus*.

TURNER (N.). **Relation between Sugar Content of Corn and Infestation and Survival of the European Corn Borer.**—*J. econ. Ent.* **44** no. 3 pp. 307–309, 2 graphs, 6 refs. Menasha, Wis., 1951.

The following is substantially the author's summary. The relation between the sugar content of maize plants and the survival of larvae of the European corn borer [*Pyrausta nubilalis* (Hb.)] was studied in Connecticut in two varieties of early and one of late sweet maize and in one inbred and two single-cross hybrid varieties of field maize.

The varieties of early sweet maize were infested more in relation to growth stage than to sugar content, and the one with the higher sugar content showed no greater survival of larvae. The field maize and late sweet maize, which were in stages of growth favourable to the survival of *P. nubilalis*, showed no relation between sugar content and infestation or survival, and one of the single crosses,

which is resistant to *P. nubilalis* in the Middle West, showed a rate of survival almost as high as that for the sweet maize.

FLEMING (W. E.), COLES (L. W.) & MAINES (W. W.). **Biological Assay of Residues of DDT and Chlordane in Soil using *Macrocentrus ancylivorus* as a Test Insect.**—*J. econ. Ent.* **44** no. 3 pp. 310–315, 2 refs. Menasha, Wis., 1951.

The chemical method recently developed for determining whether adequate DDT is present in soil round nursery plants to satisfy the quarantine regulations concerning the spread of *Popillia japonica* Newm. in the United States [*R.A.E.*, A **39** 330] can also be used for the determination of chlordan, which has been authorised for similar use against *P. japonica*, but when both compounds are present in soil it gives no indication of the quantities of each. Further, if there were a gradual accumulation of relatively non-toxic chlorine-bearing decomposition products of DDT or chlordan in the soil, the determination of total organic chlorides would not provide a true index of the toxicity of the residue.

Preliminary studies of methods of biological assay, made in 1950, showed that adults of *Macrocentrus ancylivorus* Rohw. were very sensitive to small amounts of chlorinated hydrocarbons in soil ; small variations in the amount of toxicant present caused very significant differences in response, and the reactions of the insects were complete within a few hours. The effect on the insects of small quantities of chlordan or DDT in soil or on filter paper are described ; chlordan soon results in paralysis, various stages of which or death can be used as the criterion of reaction, whereas DDT is slower in action, and death, which occurs only after some hours, is adopted as the criterion.

The first tests were made with the soil in petri dishes, but variations in the rate of reaction of the insects due to soil factors led to the use of extracts prepared with a mixture of benzene and isopropyl alcohol. These were clarified with activated charcoal and put on filter paper, which was damped with water when the solvent had evaporated. The reaction of the insects to each test sample was compared with the reactions to residues from standard solutions of the toxicant also treated with charcoal, and the toxicant in the samples was estimated and expressed as the amount per acre of soil to a depth of three inches by a formula that is given. An assay for chlordan was usually completed in three hours, but that for DDT required 18–24 hours. When both DDT and chlordan were present, the chlordan was first assayed, after which the filter papers were successively dried and wetted with water, usually 10–12 times, to facilitate the evaporation of the chlordan, until there was no reaction by *Macrocentrus* to the chlordan standards within 20 hours. The DDT, which is not affected by this treatment, was then assayed. Repeated tests showed that DDT in the amounts usually present in soil did not interfere with the assay for chlordan. Possibly the most rapid procedure in the case of a mixture would be to determine the total organic chloride chemically and the chlordan biologically and calculate the quantity of DDT from the results.

The results obtained by this method for chlordan alone and for chlordan with DDT in field soils were in close agreement with those of chemical analyses, and the results of bioassays of chlordan with *M. ancylivorus* were also in good agreement with those obtained when third-instar larvae of *P. japonica* were used as the test insects in treated soil. Preliminary tests showed that aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] resemble chlordan in their effect on *M. ancylivorus* but act more rapidly and can be determined in soil by the same method of biological assay.

GERBERG (E. J.). **An unusual Food Habit of** *Monochamus titillator* **Fab.**—*J. econ. Ent.* **44** no. 3 p. 317. Menasha, Wis., 1951.

Adults of *Monochamus titillator* (F.) were observed feeding on rayon dresses in a shop window at Catonsville, Maryland. New timber had been used in making the window, but it was not known whether the beetles had emerged from the wood.

SMITH (C. E.) & HARRISON (P. K.). **Studies of arsenical Residues on Cauliflower.**—*J. econ. Ent.* **44** no. 3 pp. 318–321, 2 refs. Menasha, Wis., 1951.

The results are given of investigations carried out in Louisiana in 1939–42 to ascertain the latest stage of development of cauliflower plants at which it is safe to apply arsenical insecticides for the control of Lepidopterous larvae. Residues of less than 0·01 grain arsenic trioxide per lb. cauliflower at harvest were arbitrarily considered to be safe [*cf. R.A.E.*, A **25** 467].

In 1939, a dust of calcium arsenate and paris green (19 : 1) was applied when the plants were small and at intervals of 10–11 days until the edible part (the curds) became visible on the most advanced plants, and in 1940–42, a mixture of calcium arsenate and paris green (10 : 1) was similarly applied until 30, 20, 10 or 0 days before the curds were expected to become visible. Arsenical residues were determined by analysing chopped samples from ten heads per plot. The sample plants were trimmed as for retail sale in 1939 but retained most of their good leaves untrimmed in the other years, as is normal for marketing in Louisiana. In 1939, the highest arsenical residue was only 0·0025 grain arsenic trioxide per lb., although in some cases the last application was made only 21 days before harvest, but in the other years, excessive residues were found on cauliflowers harvested 8–32 days after the last application and whenever the marketed portion included 17 or more leaves that had been exposed to the dust but not when the number of such leaves was 13 or less.

The total numbers of leaves retained on the untrimmed heads ranged from 26 to 52, and some of them had been exposed on the plants for 70 days, but in only one group of plants dusted more than 32 days before harvest were there more than 13 dusted leaves per plant on the marketed product. This had been last dusted 33 days before harvest and had an average of 14 leaves per plant that had been exposed to insecticide, and it therefore appears that if dusting is discontinued at least 34 days before harvest there will be no excess residue on the marketed heads. Some of the insecticide is removed from the plants by rain and other weathering agents, but not enough to eliminate the danger of poisoning. The results showed that the residue at harvest depended largely on the stage of plant development at which dusting was discontinued, and that for the plants to retain fewer than 13 dusted leaves on the marketable product, it should stop about five weeks before harvest, or when the curd begins to form. This stage cannot be recognised externally, as the developing curds are enclosed by leaves for 10–15 days. The only safe method is to split several of the most advanced plants through the centre just before an application is due to be made and to withhold treatment if the examination reveals the presence of curds more than 0·5 in. in diameter.

WOODRUFF (N.). **Control of Cutworms and Aphids on Tobacco.**—*J. econ. Ent.* **44** no. 3 pp. 322–324, 1 ref. Menasha, Wis., 1951.

Cutworms are injurious each year to tobacco in Connecticut, and in the spring of 1950, insecticides were applied to the soil in an attempt to control them on broadleaf tobacco. Dusts containing 10 per cent. DDT, chlordan or toxaphene

were applied at 30 lb. per acre and 40 per cent. toxaphene emulsion at 1 U.S. quart in 10 U.S. gals. water per acre on 31st May, and the soil remained undisturbed for 7–10 days before the plants were set. In a concurrent test against wireworms, a 50 per cent. chlordan wettable powder was applied in the setting water at 4 oz. per 50 U.S. gals., and the effect on cutworms was observed. The cut plants were counted and replaced after about a fortnight, and a further count was made a month after treatment. The results showed that toxaphene dust gave excellent protection for a month, reducing the numbers of damaged plants per 20 rows from 126 to 44. The chlordan and DDT dusts, the toxaphene emulsion and chlordan in the setting water gave 91·5, 46·4, 91·5 and 55 per cent. control, based on damaged plants, after 12 days and 68, 31·4, 68·6 and 55 per cent., respectively, after a month. Cutworm damage was heavier on land that had not been ploughed before planting, and plots treated with chlordan dust and toxaphene emulsion required less restocking than the control plots, and those treated with DDT dust and chlordan in the setting water required more.

Dusts containing 10 per cent. DDT, 3 per cent. DDT with 1 per cent. parathion or 1 per cent. parathion, applied to the plants on 14th July, before the peak of infestation by Aphids [*cf. R.A.E.*, A **38** 259], and the first two followed a week later by the 10 per cent. DDT dust, all gave excellent Aphid control. A spray of 0·2 lb. parathion per acre on 14th July and another of 2 lb. DDT with 0·2 lb. parathion per acre on the same date with or without one of 2 lb. DDT per acre a week later were also very effective, but one or two applications of a spray of 2 lb. DDT per acre were relatively useless, though both resulted in fewer Aphids than no treatment. All sprays were prepared from wettable powders.

Ditman (L. P.) & Bickley (W. E.). **On Control of the Mexican Bean Beetle.**—*J. econ. Ent.* **44** no. 3 pp. 325–328. Menasha, Wis., 1951.

Since the available rotenone insecticides have given inconsistent and sometimes unsatisfactory control of the Mexican bean beetle [*Epilachna varivestis* Muls.] on beans in Maryland for several years, various other materials were compared against it in sprays, liquefied-gas aerosols and dusts in 1949–50. In tests of six treatments on bush lima beans in 1949, single applications on 25th August of an aerosol released from a mixture containing parathion, xylene, acetone and methyl chloride (2 : 10 : 38 : 50) at about 20 lb. per acre, and a dust containing 0·25 per cent. rotenone, 0·05 per cent. pyrethrins and 0·5 per cent. n-propyl isome and a 0·83 per cent. parathion dust, both at 40 lb. per acre, gave more than 80 per cent. reduction in the numbers of larvae in 13 days, as compared with 16·9 per cent. in the control. The mixed dust appeared to give a higher kill of adults and a better yield of shelled beans than the other treatments.

When applied to lima beans on 28th August 1950, the mixed dust gave 93·4 per cent. reduction of larvae in two days, as compared with 6·3 per cent. in the control, and was more effective than 11 other treatments, including parathion, methoxy-DDT (methoxychlor) and rotenone (from cubé resins) in aerosols and parathion and rotenone in dusts. Four weekly applications in August and September of the parathion aerosol and aerosols containing S-(1,2-carbethoxyethyl) O,O-dimethyl dithiophosphate or a mixture of 2-nitro-1,1-bis(p-chlorophenyl)propane and the corresponding butane, the mixed dust, 0 ·83 per cent. parathion dust, 0·75 per cent. rotenone dust and a spray containing 1 pint of a 50 per cent. emulsion concentrate of the carbethoxyethyl dimethyl dithiophosphate per 100 gals. all gave more than 90 per cent. reduction in larval population on snap beans, reduced adult populations considerably and gave the greatest reductions in the percentage of injured pods. Some of the materials were repellent, so that adult mortality was difficult to assess.

JEPPSON (L. R.). **Bis-(p-chlorophenoxy)-methane in Relation to the Control of Citrus Red Mite and other Mites injurious to *Citrus* in California.**—*J. econ. Ent.* **44** no. 3 pp. 328–337, 8 graphs, 18 refs. Menasha, Wis., 1951.

The following is based on the author's introduction and summary. Five species of mites, *Paratetranychus citri* (McG.), *Tetranychus sexmaculatus* Ril., *T. lewisi* McG., *Aceria sheldoni* (Ewing) and *Phyllocoptruta oleivorus* (Ashm.), cause sufficient injury to *Citrus* trees or their fruits in California to justify chemical control measures. *Paratetranychus citri* is the most important. It has been controlled with petroleum-oil sprays and sprays and dusts of the dicyclohexylamine salt of dinitro-o-cyclohexylphenol, but as these materials are inadvisable for use on *Citrus* under some conditions, and di(p-chlorophenoxy)-methane gave good results against it in preliminary tests [*cf.* *R.A.E.*, A **36** 155] it was further tested against this and the other mites [*cf.* **38** 413, 492]. Against *P. citri*, a spray containing 1 lb. of the technical compound per 100 U.S. gals., dissolved in a mixture of Velsicol AR-60 and kerosene (1 : 12) and emulsified with blood-albumin spreader, was as effective as petroleum-oil sprays and not significantly different from the same compound used as a wettable powder. It gave the most consistent results when applied by conventional hand sprayers, but equally effective applications were made more rapidly under many field conditions with spray-dusters, Speedsprayers or oscillating boom-sprayers. Dusts were less effective than sprays at equal dosages of toxicant, and the addition of 2 per cent. oil as an adhesive did not improve their effectiveness. Concentrate and fog applications were ineffective.

When the compound was applied to Valencia orange trees in wettable-powder sprays at 4–12 lb. per acre, the length of time for which the residues remained toxic and the effectiveness of control increased with the dosage. High temperatures increased the rate at which the deposits lost toxicity in both laboratory and field tests.

Di(p-chlorophenoxy)methane was effective against *T. sexmaculatus* and *T. lewisi* on *Citrus* only under restricted conditions [*cf.* **38** 414] and was ineffective against *A. sheldoni* and *Phyllocoptruta oleivorus* [*cf.* **38** 493]. Plant injury to *Citrus* did not occur from either experimental or commercial applications, except at unnecessarily high dosages.

BARTLETT (B.) & EWART (W. H.). **Effect of Parathion on Parasites of *Coccus hesperidum*.**—*J. econ. Ent.* **44** no. 3 pp. 344–347, 4 refs. Menasha, Wis., 1951.

Parathion sprays applied to *Citrus* trees in California sometimes cause *Coccus hesperidum* L., which is not affected by them and is usually of no importance, to increase to serious proportions by eliminating its parasites. These are *Metaphycus luteolus* (Timb.), which attacks young to nearly mature scales, and *Microterys flavus* (How.), *Coccophagus scutellaris* (Dalm.) and *C. lycimnia* (Wlk.), which attack half grown to nearly mature scales ; *Metaphycus stanleyi* Comp., is occasionally found. *M. luteolus* is the most important and also attacks *Coccus pseudomagnoliarum* (Kuw.) and *Saissetia oleae* (Bern.). In summer, this parasite develops from egg to adult in about 18 days, completing two generations to one of *C. hesperidum*, and it is apparently unaffected by the seasonal temperatures of southern California. In laboratory cultures it killed many small scales by attempted oviposition or by its feeding punctures. When parathion is applied to *Citrus*, *C. hesperidum* becomes evident in as little as 6–8 weeks, and *M. luteolus* is absent for as long as lethal parathion residues remain in the orchard. The parasite usually becomes re-established 2–4 months after treatment and controls the scale 1–3 months later, though successive periods of scale abundance may occur for a year or more, owing to natural variation between host and parasite populations.

Laboratory tests showed that *M. luteolus* was not unusually susceptible to parathion, and that insecticidal applications had no indirect effect on the parasite through the host, scales reared on parathion-treated *Citrus* being as susceptible to parasitism as others. After treatment, scale infestations were controlled by *M. luteolus* more rapidly in the upper portions of the tree than on leaves and twigs near the ground, apparently owing to the longer retention of parathion in the soil, particularly in areas affected by the drip from the tree fringe. The availability of parasites for re-establishment in a treated orchard depends on the presence of reservoirs of *C. hesperidum* or *C. pseudomagnoliarum* in surrounding untreated areas. Since parathion can be applied to *Citrus* at almost any time of year, large contiguous areas are rarely treated at once, and this has favoured the re-establishment of parasites after the disappearance of toxic residues. It is considered that artificial colonisation of the parasites immediately after the disappearance of the toxic residue would help to prevent severe damage, and this was confirmed in two greenhouse tests.

HANNA (R. L.), GAINES (J. C.) & WIPPRECHT (R.). **Results of Tests for Greenbug Control.**—*J. econ. Ent.* **44** no. 3 pp. 347–350, 1 graph, 1 ref. Menasha, Wis., 1951.

As infestation by *Toxoptera graminum* (Rond.) was widespread on small grains in Texas in 1950, laboratory and field tests on its control were carried out. When single infested barley plants in the laboratory were dusted with 3 per cent. γ BHC (benzene hexachloride) or 1 per cent. parathion in a dusting tower or sprayed with various concentrations of γ BHC or TEPP (tetraethyl pyrophosphate) at a constant rate equivalent to 6 U.S. gals. per acre and examined after 24 hours, the plotting of dosage against mortality showed that the median lethal doses of γ BHC and parathion in dusts and γ BHC and TEPP in sprays were 0·045, 0·015, 0·041 and 0·0041 lb. per acre, respectively.

In sprays applied at 6 U.S. gals. per acre to oats in the field in the late afternoon at a temperature of 70°F., TEPP at 0·32 and 0·52 lb. per acre gave significantly better control in 48 hours than 0·31 lb. γ BHC per acre, with no significant difference between dosages, while the BHC was itself significantly better than no treatment. Parathion and γ BHC applied to oats in dusts at 0·11 and 0·44 lb. per acre, respectively, in the early morning when the temperature was 32–38°F. and the wind velocity 4–8 miles per hour, and TEPP and γ BHC applied in sprays at 0·35 and 0·38 lb. per acre later in the day, when the temperature was 53–66°F. and the wind velocity 15–20 m.p.h., all gave significant control in 48 hours, with no significant difference between treatments.

In a final test, on wheat, TEPP at 0·27 and 0·52 lb. per acre, γ BHC at 0·28 lb. and parathion at 0·19 lb. were applied in sprays at about noon, when the temperature was 56–59°F. and the wind velocity 27–31 m.p.h., and another application of TEPP at 0·26 lb. per acre was made on the following day, when the temperature was 45°F. after a light frost and the wind velocity 13–14 m.p.h. Most of the Aphids were on the leaves on the first day, but at the base of the plants on the second. Parathion and TEPP applied on the first day gave significantly better control than TEPP applied on the second, with no significant differences between insecticides or dosages of TEPP. Parathion retained its effectiveness longer, but killed more of the Coccinellids that are predacious on *T. graminum*. TEPP applied on the first day was significantly better than BHC after two days, but not after seven.

It is considered that parathion and TEPP probably gave sufficient control to enable predators and parasites to restore the natural balance under favourable conditions. The degree of control obtained with insecticides seemed to depend to a large extent on the position of the Aphids on the plants. Sprays

were more practical than dusts as they could be applied effectively when the wind was fairly high.

WEAVER (C. R.). **The seasonal Behavior of Meadow Spittlebug and its Relation to a Control Method.**—*J. econ. Ent.* **44** no. 3 pp. 350–353, 2 graphs, 5 refs. Menasha, Wis., 1951.

Since the application of insecticides against *Philaenus leucophthalmus* (L.) on leguminous forage crops in spring [*cf. R.A.E.*, A **39** 306] is sometimes inconvenient and may leave undesirable residues, alternative methods of control are desirable. Observations in northern Ohio showed that serious damage occurred mainly on forage crops in the first year of harvest, so that most of the eggs deposited in the previous autumn must be laid in the newly sown fields. These usually contain grain stubble at the time, and wheat and oat stubble provide favoured oviposition sites. Except for transient newly emerged adults migrating to them from the harvested first-year fields in June, the grain fields contain few adults until the grain is harvested and the leguminous crop produces fairly abundant foliage [*cf.* **39** 243]. During July and August, the adults are most abundant in meadows in which the vegetation is flourishing, and they move into the newly sown fields in large numbers at the beginning of September.

It was found that sprays applied in June–August caused large initial reductions in adults, but resulted in almost complete reinfestation in 10-14 days, whereas those applied in the last week of August or in September reduced the population without reinfestation. The development of eggs within the females and a decrease in migration both occur in early September, and one insecticidal application suitably timed should therefore give good control by reducing the number of eggs laid and consequently the nymphal population in the following spring.

RINGS (R. W.) & GOULD (W. A.). **Effectiveness of new organic Insecticides in controlling Plum Curculio infesting Plums.**—*J. econ. Ent.* **44** no. 3 pp. 354–359, 1 graph, 5 refs. Menasha, Wis., 1951.

As *Conotrachelus nenuphar* (Hbst.) is by far the most destructive insect pest of plums in Ohio, investigations on its control with the newer organic insecticides were continued in 1948–50 [*cf. R.A.E.*, A **37** 430]. All sprays were prepared from wettable powders and all spray quantities are per 100 U.S. gals. The following is based on the authors' summary of the results. BHC (benzene hexachloride) was ineffective when applied three times at 0·18 lb. γ isomer, and when the concentration was increased to 0·25 lb. γ isomer and the number of applications to five, excellent control was obtained, but the flavour of the processed plums was seriously impaired. Lindane [at least 99 per cent. γ BHC] at 0·24 lb. γ isomer and a refined BHC with a high content of γ isomer at 0·25 lb. γ isomer gave good control without affecting the flavour of the processed plums. Chlordan at 1 lb. was very effective, but caused moderate or severe injury on several varieties of plum and imparted an undesirable flavour to the fruits of one of them.

Parathion at 2 lb. 15 per cent. powder controlled *C. nenuphar* well except when in combination with a commercial adhesive, and there was no indication of foliage or fruit injury or flavour contamination on one variety of plum that was sprayed with 2 lb. 25 per cent. parathion five times at intervals of ten days. In 1950, a powder containing 27 per cent. EPN [ethyl p-nitrophenyl thionobenzenephosphonate], used at 1·5 lb., was about as effective as parathion. Dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] used at a concentration of 1·5 lb. 15 per

cent. powder was promising in 1950, even when only half the usual number of applications was made, but it became necessary to use parathion to control infestations of *Hyalopterus arundinis* (F.) that developed on the trees sprayed with it. Aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], used at 1 lb. 25 per cent. powder, was not significantly better than lead arsenate and also permitted an increase in the Aphid. Methoxy-DDT (methoxychlor) gave very good results when applied four times at 1 lb. Toxaphene with an adhesive gave good control on plum in 1948, but was not tested further because of poor results on peach in the same season.

Limited tests on timing indicated that the first spray against *C. nenuphar* should be applied at petal-fall and that 2–4 additional applications, depending on the severity of the infestation, at intervals of ten days are required for commercial control.

Shenefelt (R. D.) & Simkover (H. G.). **Insecticides for Control of White Grubs.**—*J. econ. Ent.* **44** no. 3 pp. 359–362, 2 refs. Menasha, Wis., 1951.

The larvae of *Lachnosterna* (*Phyllophaga*) and related Lamellicorns have caused severe losses of seedlings and transplants in forest-tree nurseries in Wisconsin, and studies of the ranges of food-plants of the adults, lengths of flight periods and distances of flight showed that control would be best directed against the larvae in the soil. In this paper, the results are given of field-cage tests of soil insecticides begun in 1947 and of field applications in four State forest nurseries.

The cage tests were designed to assess initial toxicity to the larvae and prolonged effectiveness in preventing infestation by toxicity to adults, eggs or larvae. Since the larvae were found to be most susceptible to insecticides just after hatching, first-instar examples were used in the tests of initial toxicity. When dusts or wettable powders were tested, the top three inches of soil in each cage was removed, sifted, mixed with the required amount of insecticide and replaced ; mixed grass seed was sown, and larvae introduced after the sod had become established. When emulsions or solutions were used, sod was established, the larvae were introduced, and the appropriate amount of insecticide in water was sprinkled on the ground a week later and washed into the soil with further water. In the tests on prolonged effect, adults of both sexes were introduced in spring for oviposition into cages already used for larvae, or into cages freshly treated, and provided with leaves as food. In all tests, larvae were examined after they had been exposed to insecticide for about a fortnight, and in some they were then replaced. Adults survived and oviposited in cages treated with most insecticides, but death was rapid in the first year in cages treated with aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] or dieldrin [1,2,3,4,10,10-hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethano - naphthalene], though less so in the second. The results against the larvae, which are shown in a table, indicated that in the sandy soil used, lead arsenate at 1,000 lb. per acre was highly toxic in the second year, but not in the third. Of the other materials tested, chlordan and BHC (benzene hexachloride) at suitable rates retained very high toxicity in the third year and were still fairly effective in the fourth. Aldrin and dieldrin were still highly toxic in the second year. Parathion was generally less effective, but still toxic in the third year. Wettable powders mixed into the soil generally retained their effectiveness longer than emulsions of the same materials used at the same rates. Lead arsenate and BHC cannot be recommended for use in conifer nurseries because of phytotoxicity or adverse effects on soil organisms.

The field tests were made with chlordan and indicated the necessity of treating the soil before heavy feeding by the grubs began. A timely application

of chlordan emulsion at 12 lb. actual toxicant per acre prevented feeding by a large population, and adults that developed from the survivors refused to feed, laid few eggs (which did not hatch) and died prematurely. Chlordan dust had a similar effect, but an emulsion applied after damage became visible did not prevent severe losses, even at the rate of 14 lb. active compound per acre. In 1950, when severe damage was expected, all areas in the four nurseries from which trees had been removed during the autumn of 1949 or the spring of 1950 were dusted with 10 lb. chlordan per acre, which was immediately worked into the soil to a depth of about eight inches, and areas still planted with trees were treated with chlordan emulsion at 6 lb. actual toxicant per acre by means of the overhead sprinkling system. Feeding by larvae was almost entirely prevented in all cases, whereas injury was extensive in an untreated nursery.

CUTRIGHT (C. R.). **Late Season Control of European Red Mite.**—*J. econ. Ent.* **44** no. 3 pp. 363–367, 8 graphs. Menasha, Wis., 1951.

The following is based on the author's introduction and summary. As the rate of development of populations of the European red mite [*Paratetranychus pilosus* (C. & F.)] decreases in late August and early September, the possibility of serious damage to apple in Ohio declines, but the date on which control measures cease to be profitable varies greatly from year to year and from orchard to orchard. It depends mainly on the number of mites present, the condition of the foliage available to them, the presence and number of natural enemies and the type of acaricide used in the orchard, but is also affected by the varieties grown, the duration of the infestation and the period when the overwintering eggs are laid.

From studies of these factors over a period of ten years, the author concludes that populations that develop late in the season may become significant, but are never as dangerous as those that develop in June and early July, that the trees are more tolerant of such populations and that predators are of minor importance in their control. Populations do not increase appreciably after 1st September, and one spray application of an effective acaricide after 1st August will give commercial control. Spraying after 25th August is seldom necessary.

GAINES (J. C.), DEAN (H. A.) & WIPPRECHT (R.). **Tests of Insecticides for Control of Cotton Insects during 1950.**—*J. econ. Ent.* **44** no. 3 pp. 367–372, 3 refs. Menasha, Wis., 1951.

In further tests of sprays and dusts against pests of cotton near College Station, Texas [*cf. R.A.E.*, A **37** 436; **38** 508; **39** 166] in 1950, sprays were applied during the day without regard to wind movement, and dusts early in the morning, when the plants were wet with dew. Sprays and dusts of toxaphene, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were compared against *Frankliniella tritici* (Fitch) and it is concluded from the results that sprays were more effective than dusts; aldrin and dieldrin at 0·08 and 0·09 lb. per acre, respectively, were better than toxaphene at 0·73 lb. per acre in sprays, and dieldrin showed more persistent toxicity than either aldrin or toxaphene.

Toxaphene at 2·9 lb. per acre in a dust or spray, a mixture of toxaphene and DDT (2 : 1) at 3·5 lb. per acre in a dust and 3 lb. in a spray and another of γ BHC (benzene hexachloride) and DDT (3 : 5) at 1·4 lb. per acre in a dust and 1·1 lb. in a spray were applied ten times at about five-day intervals between 29th June and 21st August against a heavy infestation of *Anthonomus grandis*

Boh. and a medium one of *Heliothis armigera* (Hb.). All materials reduced the damage, but the dusts were more effective against both insects and increased the yield more than the corresponding sprays ; toxaphene dust was the most effective material against *Anthonomus*, and the toxaphene-DDT dust mixture against *Heliothis*. Toxaphene dust gave the greatest increase in yield, and the toxaphene and BHC sprays the least. In the laboratory, toxaphene and DDT applied separately in sprays in the ratio of 2 : 1 were as effective against *Anthonomus* as similar dosages of a mixture in the same proportions, but both were more effective than toxaphene alone.

Where 12 applications were made at about five-day intervals between 30th June and 26th August, when damage by *Heliothis* was heavy and infestation by *Anthonomus* moderate, toxaphene and aldrin at 2·8 and 0·33 lb. per acre, respectively, in sprays gave significant control of the latter, but were less effective than toxaphene, γ BHC with DDT (3 : 5) or dieldrin at 2·8, 1·2 and 0·34 lb. per acre, respectively, in dusts or dieldrin at 0·32 lb. in a spray. All materials also gave significant control of *Heliothis*, but the dusts of toxaphene and of BHC with DDT, which were equally effective, were significantly better than the other treatments and gave the highest yields. When sprays containing toxaphene and DDT (2 : 1) and aldrin or dieldrin and DDT (1 : 2) were applied against both insects at approximately 3, 0·66 and 0·63 lb. per acre, respectively, there were no differences in yield between plots treated with toxaphene by aeroplane or tractor or with aldrin or dieldrin by tractor. The spray of toxaphene and DDT was more effective than a toxaphene dust when injury by *Heliothis* was heavy and infestation by *Anthonomus* comparatively light. In another test, three applications of toxaphene early in the season did not increase the control given by nine later applications of the spray of toxaphene and DDT ; both schedules increased the yield.

On late-planted cotton heavily infested by both insects, nine applications of the spray of toxaphene and DDT and one of a dust of 3 per cent. γ BHC, 10 per cent. DDT and 40 per cent. sulphur against an infestation by Aphids [*Aphis gossypii* Glov.] that developed in August resulted in an average of 1,223 lb. seed cotton per acre more than a plot that received only one application of 1 lb. toxaphene and 0·5 U.S. pint 40 per cent. tetraethyl pyrophosphate per acre against leafworms [*Alabama argillacea* (Hb.)] and Aphids in August.

In cotton fields in which *Septanychus texazona* McG. developed late in the season, sprays of 2-(p-tert-butylphenoxy)-1-methylethyl 2-chloroethyl sulphite at 0·25 lb. active ingredient per acre, p-chlorophenyl phenylsulphone at 1 lb., the 2,4-dichlorophenyl ester of benzenesulphonic acid at 1·5 lb. and p-chlorophenyl p-chlorobenzenesulphonate at 1·5 lb., applied by ground equipment, reduced the numbers of mites by 83·2, 81·9, 90·7 and 86·6 per cent. in three days, and the last was the most effective after ten days. Sprays of the first two materials were much less effective when applied from an aeroplane.

DeBach (P.) & Bartlett (B.). **Effects of Insecticides on biological Control of Insect Pests of** *Citrus*.—*J. econ. Ent.* **44** no. 3 pp. 372-383, 3 graphs, 18 refs. Menasha, Wis., 1951.

The use of DDT and other new organic compounds in pest control has emphasised the detrimental effect that chemical treatments may exert on the biological control of pests attacking orchard crops, and particularly *Citrus*, which is subject to a great variety of such applications. The authors review the literature on the inter-relations between chemical and biological control of *Citrus* pests [*cf. R.A.E.*, A **37** 288], describe the way in which DDT or any material having much more toxicity to natural enemies than to their hosts

may be used to determine the relative efficiency of biotic and abiotic factors in changing the host-population density, and give the results of investigations on the effect of chemicals on the relation between various pests of *Citrus* in California and their most important parasites and predators.

It was shown that serious increases in the cottony cushion scale [*Icerya purchasi* Mask.] after DDT treatment were caused by differential toxicity to the scale and the vedalia [*Rodolia cardinalis* (Muls.)] and that an area treated with DDT served as a trap for migrating adults of the predator and so delayed its increase and reduced its effectiveness against *Icerya* in adjoining untreated areas [*cf.* **38** 441–442].

Increases in the citrus red mite [*Paratetranychus citri* (McG.)] after spray applications of DDT, cryolite or zinc sulphate were shown to be related to the deleterious effects of these materials on its predators. The chief of these are *Stethorus picipes* Csy., *Conwentzia hageni* Banks and *Chrysopa californica* Coq.; *Oligota* (*Somatium*) *oviformis* (Csy.) is generally rare, and few predacious mites or thrips were recorded. Polyphagous Coccinellids of several genera such as *Hippodamia, Coccinella, Adalia* and *Olla* were abundant at times. The spray treatments changed the numerical proportions of the different predators and consequently their interactions with *P. citri* and alternative host species, and DDT had such distinct effects on the various species that it changed their order of importance in the natural-enemy complex.

Increases in populations of the long-tailed mealybug [*Pseudococcus adonidum* (L.)] resulted from applications of chlordan, cryolite, zinc sulphate, di(p-chlorophenoxy)methane and talc, and from light applications of DDT. Both DDT and talc have been shown to be injurious to the natural enemies of this mealybug [*cf.* **36** 145]. *Anarhopus sydneyensis* Timb., the principal primary parasite, was little affected by light dosages of DDT, but *Lygocerus*, the principal parasite of *Anarhopus*, *Tetracnemus pretiosus* Timb., the primary parasite of the mealybug next in importance, and all the predators were selectively eliminated [*cf.* **38** 443]. DDT applied at higher rates was sufficiently toxic to the mealybug to give adequate control without subsequent increases. The natural control of the California red scale [*Aonidiella aurantii* (Mask.)] by *Aphytis chrysomphali* (Merc.) that occurs in some groves [*cf.* **39** 235] was upset by monthly light applications of DDT sprays, which were more injurious to the parasite than to the host.

The authors conclude that chemical treatments may produce adverse effects on natural control by direct toxicity, by the toxic or repellent effect of materials ordinarily considered inert and by starvation of the beneficial insects due to drastic reductions in the host populations. Changes in the balance between host and natural enemies may be sudden and transient or slow and permanent. To prevent adverse results from chemical treatments, it is desirable to determine the degree of biological control attainable in the absence of treatment, adapt pest control treatment so as to conserve reservoirs of natural enemies, and determine the specificity of various chemical control measures to the natural enemies concerned.

GERHARDT (P. D.), LINDGREN (D. L.) & SINCLAIR (W. B.). **Methyl Bromide Fumigation of Walnuts to control two Lepidopterous Pests, and Determination of Bromine Residue in Walnut Meats.**—*J. econ. Ent.* **44** no. 3 pp. 384–389, 1 ref. Menasha, Wis., 1951.

Myelois venipars Dyar and *Ephestia kuehniella* Zell. are serious pests of walnuts in southern California. The former infests the nuts in the field and is brought into the packing house at harvest, but has not been shown to reproduce there, while the latter is chiefly a pest of the stored nuts. In fumigation experiments, complete control of larvae of *M. venipars* in whole walnuts was

obtained by fumigation at atmospheric pressure with methyl bromide at a dosage of 2 lb. per 1,000 cu. ft. for two hours at 65°F. when the nuts were in loosely woven cloth sacks. When they were in sealed, double-walled cellophane bags, satisfactory control could not be obtained at atmospheric pressure with dosages of 2–4 lb. methyl bromide and exposures of up to eight hours. Poor control of larvae of *E. kuehniella* in sealed, double-walled cellophane bags was also given by exposure to dosages of 2–12 lb. methyl bromide per 1,000 cu. ft. at atmospheric pressure for 1–3 hours at 55°F., but complete mortality resulted from exposure to a dosage of 2 lb. per 1,000 cu. ft. for one hour when a vacuum of 25 inches was produced, and released over a period of five minutes after the introduction of the fumigant or maintained at a slightly lower level throughout.

When whole walnuts in the cellophane bags were fumigated under vacuum with 2 lb. methyl bromide per 1,000 cu. ft., they had absorbed averages of 0·41 mg. bromine per 100 gm. fresh weight after one hour and 4·84 mg. after 21 days. The bromine residue in pieces of shelled walnut of three different sizes in cartons fumigated under vacuum with 2·86 lb. methyl bromide per 1,000 cu. ft. for 90 minutes, although very high at first, fell to 5·39–7·44 mg. per 100 gm. within 24 hours of fumigation, and was not much lower 4–7 weeks later.

It is concluded that whole or shelled walnuts that have been subjected to vacuum fumigation with methyl bromide may be expected to show high bromine residues.

Michelbacher (A. E.), Middlekauff (W. W.) & Glover (L. C.). **Studies with Aldrin and Dieldrin against Melon Insects.**—*J. econ. Ent.* **44** no. 3 pp. 390–393, 2 figs. Menasha, Wis., 1951.

Liriomyza subpusilla (Frost) sometimes causes serious injury to several varieties of melon in California by mining in the leaves. When infestation is severe, a large proportion of the foliage is destroyed, and the yield and quality of the fruits are reduced ; they are furthermore exposed to scorching by the sun. The leaf-miner is normally not important early in the season, but becomes more abundant later [*cf. R.A.E.*, A **39** 256]. In 1950, hymenopterous parasites controlled infestations that appeared likely to become severe in several fields ; *Solenotus intermedius* (Gir.) was the most abundant, and small numbers of *Chrysocharis ainsliei* Crwf., three unidentified male Pteromalids and a Braconid of the genus *Opius* were reared from the larvae and pupae.

In 1950, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were tested for control. In the first test, concentrated emulsion sprays giving 1 and 1·5 lb. aldrin and 0·5 and 1 lb. dieldrin in 20 U.S. gals. per acre were applied on 8th August and once or twice more at intervals of two weeks, and dusts containing 2·5 per cent. aldrin or dieldrin were applied at 25 lb. per acre on all three dates, all by ground equipment. Counts of the percentages of leaves having over ten mines per leaf made weekly for seven weeks until harvest showed that the sprays were more effective than the corresponding dusts and dieldrin than aldrin, with little difference due to concentration or number of applications for the sprays. In a second test with emulsions, aldrin and dieldrin were applied by aeroplane twice at 1 and 0·5 lb., respectively, in 10 U.S. gals. water per acre, and dieldrin was again more effective than aldrin ; both were superior to 3 per cent. DDT. Both materials were very effective against other important pests of melon, such as Tenebrionids, species of *Diabrotica* and *Empoasca abrupta* DeL. ; against *E. abrupta*, dieldrin had a longer residual action and was more effective than aldrin.

No phytotoxic effect was noticed, although the stronger aldrin spray may have caused a slight bronzing of the foliage, but both materials were highly toxic to honeybees. The Pacific mite [*Tetranychus pacificus* McG.] was present in all plots, but no development of destructive populations due to treatment was observed.

WEAVER (N.). **Toxicity of organic Insecticides to Honey Bees : Contact Spray and Field Tests.**—*J. econ. Ent.* **44** no. 3 pp. 393–397, 2 graphs, 10 refs. Menasha, Wis., 1951.

The author describes experiments carried out in Texas in 1949–50 on the toxicity to honey bees of BHC (benzene hexachloride), DDT, chlordan and toxaphene in sprays applied directly to them in the laboratory and to cotton in the field. In the laboratory tests, in which emulsion concentrates were used, the median lethal rates of application of a mixture of γ BHC and DDT (3 : 5) and of γ BHC, chlordan, DDT and toxaphene were 0·015, 0·02, 0·038, 0·089 and 0·224 lb. per acre, respectively. Comparison with previous tests [*cf. R.A.E.*, A **38** 371] showed that sprays were more toxic than dusts when applied directly to bees.

When bees were enclosed in large field cages over cotton that had been treated with insecticides, toxaphene sprays caused little mortality, possibly partly because they scorched the plants, but a spray of toxaphene and DDT (2 : 1) at 2–5 lb. per acre and dusts of 20 per cent. toxaphene, 10 per cent. DDT, 3 per cent. γ BHC, alone or with 5 per cent. DDT, and 10 per cent. chlordan at 10–40 lb. per acre had killed 8·2–10·4 per cent. after eight applications. Chlordan, BHC and BHC with DDT caused a marked decrease in the numbers of bees gathering nectar from the cotton, but dusts of DDT or toxaphene had little repellent effect. In cages in which the cotton was sprayed with the systemic insecticide schradan (octamethyl pyrophosphoramide) against Aphids [*Aphis gossypii* Glov.], there was some loss of bees present during the treatment, but little or none among those introduced directly afterwards. A month after treatment, the cotton was almost entirely free of Aphids, but there was no indication at any time that the nectar of the cotton was toxic to the bees.

LUDVIK (G. F.) & DECKER (G. C.). **The insecticidal Properties of some Esters of Phosphorus Acids.**—*J. econ. Ent.* **44** no. 3 pp. 405–418, 14 refs. Menasha, Wis., 1951.

The following is substantially the authors' summary. Tests were made with 132 organic esters of metaphosphoric, orthophosphoric, pyrophosphoric, triphosphoric, phosphorous and alkyl- and arylphosphoric acids for possible activity as contact insecticides against *Myzus persicae* (Sulz.) and the house-fly (*Musca domestica* L.), and 26 were found to possess at least a fair degree of insecticidal activity. These were tested further as contact sprays against a more resistant Aphid, *Myzus porosus* Sand., and the house-fly ; 24 showed fair to extreme toxicity to *M. porosus*, and 19 showed varying degrees of toxicity to the fly. The only ones that proved to be active residual toxicants to the latter were diethyl p-nitrophenyl phosphate [paraoxon], diethyl p-nitrophenyl thionophosphate [parathion] and diethyl o-nitrophenyl phosphate. These three and four others gave fair to good protection of wool from the feeding of the larvae of *Attagenus piceus* (Ol.), the first two being the most effective.

Comparisons of chemical structures in relation to toxicity indicated that certain essential chemical components were necessary to impart high toxicity in organic phosphate esters. The first requirement was that the phosphorus atom should be pentavalent and that two of its valences should be linked with

those of an oxygen or a sulphur atom. The second was that two of the remaining valences should be occupied by OR groups, where the limits of R were ethyl or isopropyl. The third concerned the group that must occupy the fifth valence. Evidence indicated that a P-R′ linkage was undesirable, that P-NR′ might be acceptable under certain conditions, but that P-OR′ yielded the highest toxicity. It was shown that R′ must differ from R and may apparently be a relatively large alkyl group, an acyl group, an aryl group or an arylacyl group. The structure $(RO)_2P(O)OR'$ is therefore considered necessary for high toxicity in an organic phosphate ester, and all the very active compounds studied conformed to this structure. The conditions imposed did not account for the activity of certain compounds showing a somewhat lower order of toxicity, such as ethyl metaphosphate, diisopropyl fluorophosphonate and ethyl p-nitrophenyl benzenephosphonate, but even though certain deviations from the suggested generalised structure have produced insecticidally active chemicals, such deviations lower the level of toxicity. The toxicity of certain phosphoric esters was shown to increase as the length of the normal alkyl chain was increased to an optimum of about eight carbon atoms. Iso-derivatives were shown to be of the same activity as their next lower normal homologues.

Bobb (M. L.). **Field Experiments for Control of Oriental Fruit Moth.**—*J. econ. Ent.* **44** no. 3 pp. 418–420, 1 graph, 2 refs. Menasha, Wis., 1951.

Cydia (*Grapholitha*) *molesta* (Busck) was controlled on peach in Virginia by larval parasites, chiefly *Macrocentrus ancylivorus* Rohw., until 1947, when the introduction of BHC (benzene hexachloride) and other new organic insecticides for control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] resulted in a reduction in parasite populations and an increase in infestation by the moth. In 1949–50, experiments were carried out to test some of the newer insecticides against it and to determine the correct timing of the sprays. The emergence and flight of the moth were observed by the use of bait-traps containing sulphite lye and water (1 : 19) with 1 cc. terpinyl acetate per U.S. quart, hung in the test orchard in trees outside the experimental plots. Wettable sulphur at 4 lb. per 100 U.S. gals. was included in all sprays. The organic materials were used as wettable powders, but all spray quantities are given as amounts of actual toxicant per 100 U.S. gals.

In a lightly infested orchard in 1949, sprays were applied against the first, second and third generations on 25th April, 8th June and 21st July, respectively. DDT at 1 lb. gave 77·45 per cent. reduction in infested fruits at harvest when applied against the first and second generations only, 42·16 per cent. when used against the second and third only, and 78·59 per cent. when applied against all three. Parathion at 0·25 lb. against all three gave 94·79 per cent. reduction, but methoxy-DDT (methoxychlor) at 1 lb. and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] at 0·5 lb. against the first, followed by DDT against the second and third, were unsatisfactory.

In a heavily infested orchard in 1950, sprays were applied on 5th May and 13th June against the first and second generations, respectively. Trees that received two applications of 1 lb. DDT, 0·25 lb. parathion or 0·4 lb. EPN (ethyl p-nitrophenyl thionobenzenephosphonate) had only 11, 56 and 9 twigs injured per tree by the larvae and showed 82·21, 83·56 and 85·23 per cent. reduction in infested fruit at harvest. On the parathion plot, fresh twig entries were noted before first-brood activity had ceased, indicating that this insecticide was effective for only 5–7 days. Applications of DDT and parathion against the second generation only were ineffective. On trees in the same orchard that were sprayed on 26th April, 5th May and 16th May against the curculio, 1 lb. chlordan, 0·5 lb. aldrin, 0·25 lb. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] or BHC, and

2 lb. lead arsenate were ineffective against *C. molesta*, but BHC in the first application followed by 0·25 lb. parathion in the second and third gave a good reduction in infested fruits at harvest and 0·25 lb. parathion or 0·4 lb. EPN in all three gave practically complete control.

BUSHLAND (R. C.). **Attempts to utilize Mosquito Larvae in a Bioassay Method for Insecticide Residues in Animal Products.**—*J. econ. Ent.* **44** no. 3 pp. 421–423, 6 refs. Menasha, Wis., 1951.

The determination of the extent to which meat and milk may be contaminated as a result of the application of insecticides to livestock is important in estimating their value ; there are sufficiently accurate methods of chemical analysis for some of the chlorinated hydrocarbons, but not for others, such as chlordan and toxaphene. As all the chlorinated hydrocarbons known to be effective against livestock pests are highly toxic to mosquito larvae and are easily tested against them in acetone-water suspension, it was thought that these larvae might be used for bioassay, but the results of unpublished experiments by C. C. Deonier & E. H. Peek showed that DDT was rendered relatively non-toxic to mosquito larvae when as little as 10 per cent. whole milk was added to the water in which it was dispersed, and that the toxic effects of chlordan and lindane [at least 99 per cent. γ benzene hexachloride] were also reduced. Further investigations on the subject are described in this paper, the insecticides used being DDT, DDD (TDE [dichlorodiphenyldichloroethane]), methoxy-DDT (methoxychlor), lindane, chlordan and toxaphene.

When chlorinated hydrocarbons contaminate milk they are found only in the butterfat, and attempts were therefore made to determine whether the substance interfering with insecticidal action would be eliminated by removing the other components of milk. Butterfat was decanted from melted butter and emulsified with sorbitan trioleate and polyoxyethylene sorbitan trioleate (8 : 1 : 1) in warm distilled water, and tests with larvae of *Aëdes aegypti* (L.) showed that most of them could survive for 24 hours in an emulsion containing 4 per cent. butterfat. When emulsions of butterfat containing 25 parts per million of the various insecticides were tested, those containing up to 4 per cent. butterfat and 1 p.p.m. insecticide all failed to kill the larvae. In an attempt to separate the insecticides from the interfering substances in butterfat, samples containing 25 p.p.m. insecticide were dissolved in chloroform, treated with a mixture of sulphuric acid and fuming sulphuric acid and washed with acetone after the evaporation of the chloroform [*cf. R.A.E.*, A **38** 315]. The acetone washings were diluted with distilled water to contain 0·25 p.p.m. insecticide and compared at that and further dilutions with standard acetone-water suspensions against the larvae. DDT and DDD samples subjected to acid extraction killed no larvae at the highest concentration, though the standards caused complete mortality at that and lower concentrations, and it seems that a turbidity that occurred when acetone washings of butterfat extracts were added to water but not when the standard acetone solutions were added, was caused by a substance that interfered with the toxicity of these insecticides. Acetone washings of butterfat contaminated with 25 p.p.m. lindane caused a similar turbidity, but the samples were toxic to the larvae, and comparison with standard acetone solutions of the insecticide indicated that lindane in butterfat was completely recovered after acid extraction. The results suggest that the biological method was sufficiently sensitive to detect 0·5 p.p.m. lindane in milk containing 4 per cent. butterfat. Chemical methods are more accurate. In similar tests with butterfat containing 25 p.p.m. toxaphene or chlordan, neither insecticide could be detected in the extract at a theoretical concentration of 0·25 p.p.m., but the standard dilutions

of these materials in acetone were also ineffective at this concentration, and it was concluded that the larvae were not susceptible enough to toxaphene and chlordan to be used in bioassay.

To test a modification by H. V. Claborn of the method for separating insecticides from beef fat [*cf. loc. cit.*], chlordan was dissolved in melted beef tallow to give concentrations of 1–8 p.p.m., subjected to the treatment with chloroform, sulphuric acids and acetone and tested against Anopheline larvae. The extracted samples appeared to be about as toxic as the standards, but there was high mortality of larvae exposed to acetone washings of fat containing no chlordan, and further tests must be made before conclusions can be drawn regarding the efficiency of the method.

BREAKEY (E. P.). **Natural Control of the Orange Tortrix in western Washington.** —*J. econ. Ent.* **44** no. 3 p. 424, 2 refs. Menasha, Wis., 1951.

Natural control of *Tortrix* (*Argyrotaenia*) *citrana* Fern. on red raspberries in western Washington, which was very slight when the insect first became a problem in that area [*cf. R.A.E.*, A **38** 25], had become almost completely effective by 1950. Parasitism was first observed in 1947, when the Braconid later described as *Meteorus argyrotaeniae* Johansen was reared from up to 5 per cent. of the larvae collected in some fields, and it increased considerably in 1948 [*cf.* **39** 330]. This parasite was very much more effective than any other present [*cf.* **38** 360] and increased to such an extent that spraying against the Tortricid was unnecessary in some raspberry fields in 1949 and necessary in only a few localities in 1950.

CHAPMAN (R. K.) & WHIPP (A. A.). **Strawberry Leaf Roller Control in Wisconsin.**—*J. econ. Ent.* **44** no. 3 pp. 424–425, 1 ref. Menasha, Wis., 1951.

Ancylis comptana (Froel.) (*fragariae* (Walsh & Ril.)), which has been very injurious to new strawberry plantings in Wisconsin in recent years, has proved difficult to control after the larvae are enclosed within the webbed leaflets. As infestation is rarely noticed until leaf-folding has occurred, tests of various insecticides against the enclosed larvae were begun in 1948 in several plantings set out for the 1949 crop. Dusts of 2 per cent. parathion, 5 per cent. toxaphene, DDT or chlordan, 0·75 per cent. rotenone, 0·15 per cent. pyrethrins or 10 per cent. calcium arsenate and sprays of 1 lb. 25 per cent. wettable parathion, 0·5 U.S. pint benzene hexachloride (containing 20 per cent. γ isomer) or 1 U.S. pint technical tetraethyl pyrophosphate per 100 U.S. gals. per acre were applied in mid-July. Insect counts made after two days showed that parathion, in spray or dust, afforded good control of the enclosed larvae, the other materials giving very poor results. Parathion took about two days to produce its maximum effect, and this was confirmed when the parathion spray was applied to strawberry plants in commercial plantings. The control percentages were 30 after one day, 94 after two and 97 after three.

BROWN (L. R.) & DEWEY (J. E.). **Control of the Apple Leaf-curling Midge with DDT in Codling Moth Sprays.**—*J. econ. Ent.* **44** no. 3 pp. 425–426, 2 refs. Menasha, Wis., 1951.

Larvae of the Cecidomyiid, *Dasyneura mali* (Kieff.), which occurs in the New England States and New York, feed on the young leaves of apple, causing them to curl, particularly on vigorous trees with many growing tips, but it is not known whether the damage causes any reduction in the quantity or quality of the fruits.

In 1946, two heavily infested apple orchards in New York were sprayed with 2 lb. 50 per cent. DDT wettable powder or with 3 lb. lead arsenate with 3 lb. hydrated lime per 100 U.S. gals. water on 26th June and 9th and 22nd July, the dates of the first three cover sprays against the codling moth [*Cydia pomonella* (L.)]. The sprays were applied at 22·5 U.S. gals. per tree with a conventional high-pressure sprayer and at 25 U.S. gals. per tree with a Speed-sprayer [*cf. R.A.E.*, A **34** 195]. Examination of the leaves on 9th September showed 99 and 63 injured leaves per 16 terminals on trees sprayed with lead arsenate and 54 and 33 on those treated with DDT. The differences between the insecticides were highly significant, and it was also observed that the extent of injury per leaf was much less on the trees that received DDT than on the others.

It was concluded that good control of the Cecidomyiid would be obtained by the use of DDT in the codling-moth cover sprays, but subsequent observations indicated that severe infestations would be better controlled by special applications of DDT in the petal-fall spray or those applied against the curculio [*Conotrachelus nenuphar* (Hbst.)].

Simkover (H. G.) & Shenefelt (R. D.). **Effect of Benzene Hexachloride and Chlordane on certain Soil Organisms.**—*J. econ. Ent.* **44** no. 3 pp. 426–427, 2 refs. Menasha, Wis., 1951.

Since BHC (benzene hexachloride) and chlordan are effective against Lamellicorn larvae in forest tree nurseries [*cf. R.A.E.*, A **39** 340], their effect on certain soil micro-organisms was investigated. Preliminary laboratory tests indicated that crude BHC dust greatly inhibited mycelial growth of *Rhizoctonia* on agar slants, whereas chlordan dust had no effect, and when a virulent strain of *Rhizoctonia* from pine seedlings in Wisconsin was inoculated into sandy soil treated with BHC at 1 lb. γ isomer per acre or chlordan at 10 lb. per acre, the average percentage of seedlings of Norway pine [*Pinus resinosa*] growing in these and untreated sand that suffered from damping off were 1·67, 9·23 and 21·07 four weeks after sowing and 18·67, 65·63 and 69·03 five weeks after it, when 9·47, 24·73 and 25·67 per cent. of the plants had failed to emerge, respectively.

When one-year-old seedlings of *P. resinosa* and white pine [*P. strobus*] grown in untreated soil or soil treated with 10 lb. chlordan per acre were examined for mycorrhizae, no differences could be detected in their abundance, but seedlings of *P. resinosa* grown in the greenhouse in soil treated with BHC at 0·25, 0·5 or 1 lb. γ isomer per acre showed noticeable differences from the controls in the numbers of mycorrhizal rootlets, the number decreasing as the dosage increased. When BHC was used at 2·5 and 5 lb. γ isomer per acre, root clubbing was so severe that inspection for mycorrhizae was impossible.

Examination of seedlings of black locust [*Robinia pseudacacia*] grown for eight weeks in sandy soil treated with 10 lb. chlordan or BHC at 1 lb. γ isomer per acre showed no differences in root nodulation due to nitrogen-fixing bacteria. The root systems of plants grown in both treated soils compared favourably with those in untreated soils in this respect.

York (G. T.) & Prescott (H. W.). **Determination of Grasshopper Control from Insecticide Treatments in Field-plot Tests.**—*J. econ. Ent.* **44** no. 3 pp. 427–428, 6 refs. Menasha, Wis., 1951.

The results of work on grasshopper control in the United States are now usually evaluated by the sweep-net method, but counts made at intervals of two hours showed that evening catches were 300–800 per cent. greater than those made during the middle of the day, whereas counts made at the same times with a cage similar to one already noticed [*cf. R.A.E.*, A **21** 611] but with an

inside area of 0·5 sq. ft. and no top showed only 12–61 per cent. variation. In tests carried out in Arizona in April 1949, fields of lucerne in which the second cutting was 4–10 inches high were treated with six unspecified baits for the control of grasshopper nymphs, and samples were taken 3–5 days later from 1–3 sweeps of a net or from the cages. Control percentages were calculated by Abbott's formula [**13** 331], and analysis of the results showed that the two methods gave comparable results, with no significant differences between them. The sweep-net method showed great variations in the catch of grasshopper nymphs and many other insects due to time of day and meteorological conditions, which would make it of little value in population studies, but it seemed suitable for evaluating control on field plots provided that treated and untreated plots were sampled within a short time. Sampling with the cage was at least as fast as sampling with the net, but more tiring ; it showed less variation owing to meteorological conditions than the net, and is therefore probably more useful when the weather is unfavourable for sweeping.

Whipp (A. A.) & Chapman (R. K.). **Control of the Variegated Cutworm on Red Beets with DDT and Chlordane Sprays.**—*J. econ. Ent.* **44** no. 3 p. 430, 6 refs. Menasha, Wis., 1951.

An outbreak of *Peridroma saucia* Hb. (*margaritosa* (Haw.)) occurred in fields of red beet in south-eastern Wisconsin in 1948. The larvae defoliated the plants and fed on marketable roots, causing considerable losses, and attempts were therefore made to control an even more severe one that developed during the summer of 1949. DDT and chlordan were applied at 1 lb. per acre in 75 U.S. gals. spray with a high-pressure machine about 25 days before harvest, and estimates of the results were made three days later by shaking the plants and counting the numbers of larvae found on the ground. The sprays gave 97 and 89 per cent. reduction, respectively, as compared with no treatment, and observations in several other fields sprayed with these materials substantiated these findings.

Hanna (R. L.) & Gaines (J. C.). **Lime-free Calcium Arsenate mixed with organic Insecticides for Cotton Insect Control.**—*J. econ. Ent.* **44** no. 3 pp. 430–432, 4 refs. Menasha, Wis., 1951.

Further tests were made near College Station, Texas, in 1950 on the value of dust-mixtures of lime-free calcium arsenate and organic insecticides in controlling the weevil, *Anthonomus grandis* Boh., and the bollworm, *Heliothis armigera* (Hb.), and preventing increases of *Aphis gossypii* Glov. on cotton [*cf. R.A.E.*, A **38** 254, 328, 509 ; **39** 8]. In the first tests, infestation by the weevil was severe throughout the season, with many adults emerging from hibernation during May and June, so that treatment was necessary to protect the early squares, and bollworm infestation was moderate from the middle of July. Insecticides were applied nine times from 22nd June to 15th August at an average rate of 15 lb. per acre, and mixtures of lime-free calcium arsenate with 1 per cent. γ BHC (benzene hexachloride) or 0·5 per cent. parathion and of 20 per cent. toxaphene with 40 per cent. sulphur all gave significant control of the weevil and bollworm and increases in yield, with no significant differences between them. Severe infestation of the surrounding cotton by *A. gossypii* subjected the plots to a constant migration of Aphids, and an application of 3 per cent. γ BHC to the whole area was necessary to prevent damage. All plants on the treated plots had fewer Aphids than those receiving only the aphicidal dust, those treated with toxaphene and sulphur having the fewest and those treated with calcium arsenate and BHC the most.

On plots on which weevils increased steadily from a moderate infestation at the beginning of July to an extremely heavy one by the beginning of August and bollworm infestation was moderate from the middle of July, eight applications of the dusts of calcium arsenate with parathion and toxaphene with sulphur and one of 10 per cent. chlordan with 5 per cent. DDT were made between 3rd July and 8th August at an average of 12 lb. per acre. All gave significant control of the weevil, the first but not the third being significantly better than the second, and the last two but not the first being significantly better than no treatment against the bollworm, with no difference between them ; all gave significant increases in yield. Where weevil infestation was negligible throughout the season and bollworm infestation severe for the last half of July but light thereafter, six applications between 13th July and 12th August of calcium arsenate containing 1 per cent. γ BHC and 2·5 or 5 per cent. DDT, calcium arsenate containing 0·5 per cent. parathion and 2·5 per cent. DDT and the mixture of toxaphene with sulphur were tested against the bollworm and all gave significant control and increases in yield ; calcium arsenate containing BHC and 5 per cent. DDT was significantly better than toxaphene with sulphur There was no increase of the Aphid on any plot.

From these and the previous results, it is concluded that lime-free calcium arsenate with 1 per cent. γ BHC or 0·5 per cent. parathion is at least as good as any insecticide in general use for controlling the weevil, that these proportions of BHC or parathion will prevent Aphid increase except in extreme cases, and that the addition of 2·5 per cent. DDT to these mixtures gives excellent bollworm control.

BROWN (L. R.). **A Method for estimating zonal Areas of Apple Skin in Insecticide Residue Studies.**—*J. econ. Ent.* **44** no. 3 pp. 432–433, 1 fig., 2 refs. Menasha, Wis., 1951.

For the purpose of regulations, insecticide residues on fruits are usually expressed as parts of insecticide per million parts of fruit, but amounts per unit area of fruit surface would be more suitable for studying the weathering of residues or their toxicity to insects. Since the calyx and stem areas of an apple may receive more insecticide deposit per unit area than the cheek of the fruit, deposits on the latter appear to be of critical importance.The author therefore constructed a slicer by means of which a disk about 1·6 cm. thick could be cut out of the middle of an apple perpendicular to the axis. The insecticide residue was removed from the skin of the disk, and the area of the skin was determined by peeling and measuring or calculated from the diameter of the disk and its thickness.

This method has the advantage that it can be used to determine the area of critical importance rapidly and the disadvantages that there is a possibility of contamination of cut areas with insecticide, that only limited skin areas are sampled and that it is not well adapted to determining increases of skin area due to fruit growth, which are important when it is desired to account for the reduction of residues as a result of it.

NICKELS (C. B.). **Notes on the Life History and Habits of the Pecan Nursery Casebearer in Texas.**—*J. econ. Ent.* **44** no. 3 pp. 433–434, 1 ref. Menasha, Wis., 1951.

Acrobasis caryivorella Rag. often causes considerable damage to small pecan trees in nurseries and new plantings in central, southern and eastern Texas, being particularly abundant on thrifty trees. Vigorous shoots on top-worked pecan trees are also sometimes injured severely, but infestation otherwise is not usually serious on large trees.

Insectary and field studies made between 1935 and 1945 showed that there are up to four generations a year in central Texas and that the life-history is somewhat similar to that of *A. caryae* Grote [*cf. R.A.E.*, A **15** 70]. The eggs are deposited on pecan leaflets or twigs, particularly near the nodes, sometimes in groups of 10–70 or more. Larvae of the last generation of the year overwinter in small hibernacula, chiefly in crevices or wound scars in the bark of trees just above or below ground level, but a few occur on the trunks up to 2 ft. above ground or near buds higher in the tree, and those from earlier generations may also overwinter under certain conditions. The hibernacula are constructed between August and December. The overwintered larvae move to the buds when these are opening, usually in late March or early April in central Texas, and destroy these and sometimes the leaf petioles. Later in the year, the larvae hollow out shoots and green twigs or feed on the leaves ; the latter are attacked chiefly by larvae of the midsummer and autumn generations, and especially during periods of drought, when the production of suitable shoots is retarded. Nuts are rarely attacked in the field. There are normally five larval instars, and the larvae pupate in cocoons spun in the folded leaflets. Moths of the overwintered generation usually emerge in late April or May, but sometimes do so as late as early June. In August 1935, the egg, larval and pupal stages of the second generation averaged 4, 19·7 and 7·9 days, the oviposition period lasted 10–14 days and females deposited an average of 142 eggs ; in September, the pupal stage of the third generation averaged 11·7 days. Adults of the first, second and third generations emerged between 26th June and 18th July, 3rd and 29th August and 3rd September and 6th October, respectively.

The larvae are frequently attacked by parasites. *Nemorilla floralis* var. *maculosa* (Mg.) is the most abundant in central Texas, and others are *Apanteles carpatus* (Say), *A. epinotiae* Vier., *Ephialtes* (*Calliephialtes*) *grapholithae* (Cress.), *Goniozus foveolatus* Ashm. (*hortorum* Brues), *Horismenus floridanus* (Ashm.), *Itoplectis conquisitor* (Say), *Mesostenus thoracicus* Cress., *Neopristomerus appalachianus* var. *dorsocastaneus* (Vier)., *Spilochalcis flavopicta* (Cress.), *S. igneoides* (Kby.) and an undescribed species of *Sympiesis*. The hyperparasites, *Eupelmus cyaniceps* var. *amicus* Gir. and *Phanerotoma tibialis* (Hald.), were reared from parasitised larvae.

SALKELD (E. H.). **A toxicological and histophysiological Study of certain new Insecticides as " Stomach Poisons " to the Honey Bee** *Apis mellifera* **L.**— *Canad. Ent.* **83** nos. 2–3 pp. 39–61, 12 figs., 35 refs. Ottawa, 1951.

The following is substantially the author's summary. An account is given of investigations in Canada on the toxicological effects of acid lead arsenate, DDT and parathion on honey bees. All bees used were first subjected to a 24-hour conditioning period under controlled temperatures, although this was later shown to be unnecessary. Each was kept in a separate cage and an individual feeding technique was used to administer a measured dose of insecticide to each bee. The median lethal dose for each insecticide was found by the dosage-probit method. Both DDT and arsenic are slow-acting insecticides (requiring 1–2 days for full effect), and since mortality counts were taken 12 hours after the toxic meal, the median lethal doses were high. Parathion was found to be a very fast-acting and toxic insecticide for bees. The hyperactivity of DDT-poisoned bees and the hyperactivity and circus movements of parathion-poisoned bees indicated that both insecticides were acting as nerve poisons. No characteristic movements were noticed with arsenic-poisoned bees. Distinct macroscopic changes were noticed in the ventriculi of some bees poisoned with DDT and arsenic ; a large transparent gas bubble was seen in the ventriculi of about 50 per cent. of the DDT-poisoned bees, whereas the mid-

gut of arsenic-poisoned bees was characterised in 90 per cent. of the cases by a greyish plug-like mass at or near the hind region. The mid-gut from parathion-poisoned bees showed no abnormality. It seems possible that these observations could be used as a means of identifying insecticides causing death of honey bees in the field. No apparent histological changes were noticed in the mid-gut from parathion-poisoned bees. Distinct histological differences from the normal structure were seen in mid-guts from DDT-poisoned bees. The epithelial lining was stretched to enclose a gas bubble, and increased secretory activity of the epithelial cells appeared to be a characteristic feature. Vacuolisation, defoliation and degeneration of the epithelial cells were characteristic of the mid-gut from arsenic-poisoned bees. The possible modes of action of these three insecticides are discussed.

SHEPARD (H. H.). **The Chemistry and Action of Insecticides.**—$9\frac{1}{4} \times 6$ ins., vii + 504 pp., 22 figs., many refs. New York, N.Y., & London, McGraw-Hill Book Co., Inc., 1951. Price $7.00 or 59*s.* 6*d.*

This book is a revised and enlarged edition of an earlier work [*R.A.E.*, A **28** 147]. Its scope remains the same, but the subject matter has been brought up to date, rearranged and almost entirely rewritten. The insecticides dealt with are now grouped according to their chemical relationships, and the sections most notably expanded are those on synthetic organic insecticides and mode of action. In general, the book covers the literature up to 1949.

JENKINS (C. F. H.). **Aerial Baiting for the Control of the Little Plague Grasshopper** (*Austroicetes cruciata* **Sauss.**).—*J. Dep. Agric. W. Aust.* (2) **27** no. 2 pp. 164–170, 5 figs. Perth, W.A., 1950.

The effectiveness of aircraft in the distribution of poison bait for the control of *Austroicetes cruciata* (Sauss.) was tested in Western Australia in 1949, the bait used consisting of bran moistened with water and poisoned with benzene hexachloride. An Anson aircraft was fitted with a hopper from which the bait passed through a chute opening in the floor, the flow of bait was controlled by a shutter, and clogging was prevented by a system of blades fitted into the base of the hopper. The flights were made at altitudes of 100–150 ft., and at the greatest height, effective distribution over swathes of 22–30 ft. was obtained. Runs were made up and down the area to be baited and across the wind, and the bait was applied both in strips and as a complete cover. The aircraft was directed by means of white marker flags, and wireless communication was maintained throughout the flight. The tests, in which a total of 230 acres was covered, were made in four districts, differing in topography but all with large, uniformly distributed populations of *A. cruciata*. The bait was distributed at a rate of about 35 lb. dry bran per acre, and one load was sufficient to treat about 32 acres. The distribution obtained was in general satisfactory, but the bait tended to form lumps more readily than when distributed by ground machines. Scattered storms followed treatment and caused a temporary reduction in feeding by *Austroicetes*, but large numbers of dead individuals were found on the next day. The cost of the operation, which is discussed, was considerably higher than that of applying the bait from the ground. It is concluded that, although bait can be effectively applied from the air, this method is not at present of any advantage where narrow strips in cultivated areas are to be treated. Aircraft may be of value for treating inaccessible breeding grounds, but as *A. cruciata* is not strictly a migratory species, their use there may not be justifiable without taking into consideration the value of the crops to be protected.

JENKINS (C. F. H.), FORTE (P. N.) & RYAN (F. E.). **The Apple Leafhopper (*Typhlocyba froggatti* Baker) and its Control at Donnybrook, Western Australia.**—*J. Dep. Agric. W. Aust.* (2) **27** no. 2 pp. 209–226, 8 figs., 5 refs. Perth, W.A., 1950.

Sprays of nicotine sulphate have been recommended against *Typhlocyba froggatti* Baker, which spread rapidly on apple through the south-west of Western Australia since it was first recorded there in 1942 [*R.A.E.*, A **32** 227], but as DDT showed promise as a substitute [**36** 74], further trials with this material were made during 1947–48. The experimental orchard had been heavily infested by *T. froggatti* in 1946, when sprays and dusts of DDT had been used against it ; winter oil sprays had been applied for many years against *Bryobia* [*praetiosa* Koch], and *Aphelinus mali* (Hald.) and *Leis conformis* (Boisd.) had been introduced to control the woolly Aphid [*Eriosoma lanigerum* (Hsm.)], which as a result was usually held in check from January of each year. Populations of Jassid nymphs and adults on the leaves were estimated before and after each application by a modification of a method already noticed [**33** 44], which is described, and the numbers of overwintering eggs in twig samples were counted at the end of the experiment. A spray containing 1 pint nicotine sulphate and 1 gal. white oil in 80 gals. water applied when the first adults appeared on the trees and again three weeks later [**32** 228] was effective against both generations and significantly reduced the number of overwintering eggs. A pre-bud-burst spray of 0·1 per cent. p,p'DDT applied when the first nymphs were hatching effectively controlled the early Jassids, but lost its toxicity after 3–4 weeks, before all the eggs had hatched, and at the end of the season the number of overwintering eggs on trees treated with it was almost as high as on the controls. A single application of the DDT spray made when adults were appearing was as effective as the two of nicotine sulphate and significantly superior to the single pre-bud-burst application of DDT. No advantage was gained by preceding it by a pre-bud-burst spray of DDT or following it, three weeks later, with a spray of 1 pint HETP (hexaethyl tetraphosphate) in 80 gals. water, and when the same amount of HETP was incorporated into the DDT spray, the initial mortality given by the latter was reduced. At current prices, one application of DDT was considerably cheaper than two of nicotine sulphate ; when made after petal-fall, against the newly emerged adults, it would not affect bees, and its date of application would coincide with that recommended for spraying against Geometrid larvae and spring beetle [*Colymbomorpha lineata* Blkb.] against both of which DDT is effective. Nicotine sulphate and the combined spray of HETP and DDT both reduced populations of *Bryobia*, the former significantly ; the sprays of DDT alone caused no significant increase in mite populations. None of the treatments interfered with the biological control of *E. lanigerum*.

Observations on the life-cycle of *T. froggatti* [**32** 228] are given in an appendix. Overwintered eggs hatched between about 30th September and 30th November 1947 ; nymphs were present until the third week in December, and adults, which were first observed on 3rd November, until the third week in January 1948. First- and second-instar nymphs of the next generation were found on 20th January, and nymphs were present until the end of March. Adults occurred from 10th February until the end of April, by which time only very few persisted.

RYAN (F. E.). **Trials with new Insecticides in Fruit Fly Control.**—*J. Dep. Agric. W. Aust.* (2) **27** no. 2 pp. 226–238, 6 figs. Perth, W.A., 1950.

BHC (benzene hexachloride), DDT and HETP (hexaethyl tetraphosphate) were tested for the control of *Ceratitis capitata* (Wied.) in Western Australia in 1946–49. In laboratory cage trials, baits of 0·025–0·156 per cent. γ BHC

in sugar solution were much more rapid in their knockdown effect on the adults than either the standard sodium-fluosilicate bait [*R.A.E.*, A **27** 131] or 1 oz. HETP and 2½ lb. sugar in 4 gals. water. A bait containing 0·156 per cent. p,p′DDT was much slower in action than the standard one. In a field test in which bait-sprays containing sodium fluosilicate or 0·05 per cent. γ BHC were applied weekly to two pear trees, neither gave complete protection, but the former was somewhat more effective. In another test, the BHC bait-spray killed 50 per cent. of the fruit-flies on an orange tree in 24 hours, and a further application when the flies had reappeared controlled them in three days. In a large-scale experiment on orange in 1949, in which the toxicants were incorporated in 6·25 per cent. sugar solution, the percentages of fruits punctured were 4·6 for 0·167 per cent. sodium fluosilicate, 19·9 and 1·6 for 0·01 and 0·05 per cent. γ BHC, and 6·1 for 0·03 per cent. of the active ingredient of E605 [parathion]. Fruit-fly activity was found to differ in intensity on different aspects of the tree, and there was also considerable variation from tree to tree and between different parts of the same orchard.

In preliminary laboratory tests on soil treatments, adults were killed by contact with deposits of BHC or DDT. They died soon after emerging from soil the surface of which had been dusted with BHC at rates of 0·13–2·08 lb. γ BHC per acre or sprayed with it at 1 or 10 lb. γ BHC per acre, but p,p′DDT applied in dusts at 0·5 or 2 lb. per acre and in sprays at 1 or 10 lb. per acre was ineffective. When γ BHC at 0·26 lb. per acre was applied as a dust to the soil in a field trial, it had no effect on fruit-flies emerging from it, though in one test the average survival period of adults that emerged a few days after the application was reduced from 25–30 to 7–8 days. This was attributed to a fumigant action of the BHC, the effects of which were later confirmed in a laboratory experiment. In a further field test, a dust of 0·26 per cent. γ BHC afforded some control of emerging adults when applied at about 3 cwt. per acre to the surface of soil on which infested apricots had fallen, but was ineffective at about 1 cwt. When fully fed larvae were exposed in the laboratory on moist or dry mixtures of three parts sand and one part of a dust containing 2 per cent. p,p′DDT or 0·26 per cent. γ BHC, DDT did not prevent pupation but killed the adults as they emerged from the surface, while BHC killed the larvae and its effect was shown not to be due to fumigation. In another laboratory experiment, in which BHC was incorporated into the soil to a depth of 0·5 in. at rates of 2·43, 1·21 and 0·24 lb. γ BHC per acre and exposed to summer weather for 4–6 weeks, the BHC at the highest rate killed most of the fully developed larvae, and the few pupae that were formed were abnormal and died. At the lower rates, it permitted the emergence of very few adults, all of which died in a few hours.

Growers in Western Australia are required to dispose of all fruits infested by *C. capitata* by boiling or burning them [**27** 131], but both operations are often difficult to perform, and in an attempt to discover a more practicable method, the effect was tested of burying the fruits in pits 1 ft. square and 1·5 ft. deep, the bottoms and sides of which were heavily sprayed with 0·5 per cent. γ BHC. No fruit-flies emerged from infested apricots that were placed in a treated pit and given one light or heavy application of the spray or of a dust containing 1·3 per cent. γ BHC or weekly heavy applications of the dust, and none emerged in a similar test from infested figs that were placed in a pit the bottom and sides of which had been dusted with 1·3 per cent. γ BHC and were themselves treated with the dust. Evidence was obtained of a strong fumigant action in the pits. Growers frequently immerse infested fruits in water for a few days until they can be destroyed. No advantage in larval mortality was obtained from adding BHC to the water used for this purpose, but if fruits steeped in this liquid were emptied into a pit, conditions similar to those in the treated pits would be produced and should give control.

HILL (A. V.) & HELSON (G. A.). **Distribution in Australia of three Virus Diseases and of their common Vector** *Orosius argentatus* **(Evans).**—*J. Aust. Inst. agric. Sci.* **15** no. 3–4 pp. 160–161, 1 map, 7 refs. Sydney, 1949.

A map is given showing the distribution by localities in Australia of witches' broom of lucerne [*R.A.E.*, A **39** 41], virescence of tobacco, tomato and other plants [**32** 65] and yellow dwarf of tobacco [**30** 279], and of the Jassid, *Orosius argentatus* (Evans), which transmits all of them. All three diseases occur in all the States of the mainland, witches' broom of lucerne and virescence are also present in the Northern Territory, and virescence occurs only on plants other than tobacco and tomato in Tasmania. *O. argentatus* is widely distributed throughout Australia, occurring in all the States and the Northern Territory.

MARTYN (E. J.). **An Outbreak of** *Oxycanus fuscomaculatus* **Walker on King Island.**—*J. Aust. Inst. agric. Sci.* **16** no. 3 pp. 105–107, 2 figs., 2 refs. Sydney, 1950.

Oxycanus fuscomaculatus Wlk., the adults, larva and pupa of which are briefly described, has been recorded from several places on the main island of Tasmania, but is not normally of major importance. In 1949, however, 250 acres of grassland on two properties on King Island were completely denuded by larvae of this Hepialid, much of the damage extending over patches 15–20 acres in extent. The outbreak was confined to calcareous and semi-calcareous sand areas on the west coast. Some larvae also occurred in a pocket of the same soil types on the east coast, but did not cause severe damage.

The larvae were fully grown in early August, and only one generation appeared to be present. The denuded areas were on unimproved pasture in which *Bromus gussonii* was dominant, and improved pastures composed mainly of perennial rye grass [*Lolium perenne*] and subterranean clover [*Trifolium subterraneum*] were less severely damaged. The larvae also killed tufts of *Poa* spp. by feeding on their roots and some fed on dung, but this may have been due to hunger, since many of the larvae were obviously suffering from starvation and there appeared to be little migration from denuded to undamaged areas, even when they adjoined. Pupae were not present in January 1950, but were found on 16th March. Adults appeared on 21st April and reached peak numbers on 6th May, after heavy rainfall.

GRYLLS (N. E.). **Low-volume D.D.T. Spray Treatment of a Lucerne Seed Crop.**—*J. Aust. Inst. agric. Sci.* **16** no. 4 pp. 154–157, 1 fig., 11 refs. Sydney, 1950.

In the test described, which was carried out in New South Wales in 1949–50, emulsified solutions of 0·1, 0·5 and 3 per cent. p,p'DDT were applied at a rate of 4 gals. per acre by low-pressure equipment mounted on a jeep to lucerne immediately before flowering and again three weeks later, when most of the flowers had set. Counts of *Orosius argentatus* (Evans), other Jassids, and the larvae of Lycaenids, Geometrids and *Heliothis armigera* (Hb.) were made before and after each application, and the results are shown in a table. They indicate that a concentration between 0·5 and 3 per cent. DDT would give control of the Lepidopterous larvae, *O. argentatus* and *Empoasca* spp., but not of various Jassids of minor importance, which were not numerous. All treatments apparently gave increases in the yield of seed, varying with the concentration of DDT applied.

Wahlin (B.). **DDT i kampen mot vetemyggan.** [DDT in the Control of the Wheat Gall-midge.]—*Växtskyddsnotiser* 1949 no. 2 pp. 1–5, 2 figs. Stockholm, 1949.

Early experiments in Sweden on the use of DDT against *Contarinia tritici* (Kby.) on wheat did not give encouraging results. A dust applied from an aeroplane in 1945 did not spread well and its effect was destroyed by ensuing unfavourable weather, and though sprays applied by tractor-drawn apparatus in 1947 and 1948 gave good reductions of adults, the damage caused by the tractors was excessive. In the last of these years, however, containers packed with a proprietary product containing 60 per cent. DDT that emitted a DDT smoke when ignited became available. They were intended for use in greenhouses, but were tested in the field in June against the ovipositing adults of *C. tritici*. Preliminary tests gave poor results, but in a third, in which the smoke was released in the evening from several containers held by operators who walked quickly across the field and was allowed to drift down the field, the average number of adults per 10 sweeps of the net was reduced from 1,696 before treatment to 6 after it, and the ground was found to be covered with the dead and dying midges. Later investigations showed that the percentage infestation was 0·1, as compared with 3–8 for no treatment. As the effect of the smoke is only temporary, it is thought that up to three applications would be required, but even so, the method would be far simpler and cheaper than any yet known.

Borg (Å.). **Begasningsförsök med cyanväte mot blodlusen.** [Fumigation Tests with Hydrocyanic Acid Gas against the Woolly Aphis.]—*Växtskyddsnotiser* 1949 no. 2 pp. 9–13, 2 figs. Stockholm, 1949.

Hydrocyanic acid gas generated from Cyanogas calcium cyanide is being used in Sweden for the fumigation of apple stock distributed from districts in which *Eriosoma lanigerum* (Hsm.) is present to those in which it is not [*cf. R.A.E.*, A **39** 130], and tests were carried out in 1948 with Cyanogas of United States origin to ascertain effective schedules. The concentrations of gas are given as volumes per cent., and they were calculated by a method described in a paper already noticed [**22** 669]. Infested apple branches were exposed to the gas in a fumigation chamber for six hours, and the minimum concentrations that gave complete mortality of adults and nymphs were 0·01 and 0·03 per cent., respectively, when the temperature was about 18°C. [64·4°F.] and 0·015 and 0·04 per cent. when it was about 9°C. [48·2°F.]. These results were superior to those obtained with Cyanogas of German origin in 1946, when a calculated gas concentration of 0·07 per cent. was required to obtain complete mortality of the Aphid. The discrepancy was attributed mainly to differences in the two samples of Cyanogas used, and this was supported by chemical analyses, which also showed that the amount of hydrocyanic acid gas given off by Cyanogas fell greatly with storage, although the containers were apparently tightly closed. It might also have been due to differences in the resistance of the particular Aphid colonies used.

In tests in December 1947, no damage was caused to apple stock exposed for six hours to gas concentrations of up to 0·32 per cent. at about 14°C. [57·2°F.], even when the trunks and roots were first wetted, although in previous work in 1946, in which trees of five varieties had been fumigated in April, when the buds had begun to swell, those of one variety were injured by exposure for 18 hours to concentrations down to 0·05 per cent. It is concluded that there is little risk of damage in practical work provided that fumigation is carried out while the trees are fully dormant.

Sylvén (E.). **Om åkertripsen och dess bekämpning.** [*Thrips angusticeps* and its Control.]—*Växtskyddsnotiser* 1949 no. 3 pp. 1–4, 2 figs. Stockholm, 1949.

The author summarises the life-history of *Thrips angusticeps* Uzel from a paper by Buhl [*R.A.E.*, A **22** 267], gives references to records of its occurrence in Sweden [**12** 434 ; **33** 36] and describes an experiment carried out on its control on spring rape in the south of that country. Treatments were applied on 6th May, and counts of the thrips on 30 plants after five days showed that the numbers were reduced from 267 for no treatment to 257 by a spray of 0·5 per cent. DDT at about 36 gals. per acre, 183 by a mixed dust of DDT and benzene hexachloride, and 1 by a spray of 0·02 per cent. of a preparation containing 35 per cent. parathion at about 72 gals. per acre.

Wahlin (B.). **Angrepp av rapsvivlar i norra Götaland.** [Attack by Rape Weevils in northern Götaland.]—*Växtskyddsnotiser* 1949 no. 3 pp. 10–12, 1 fig. Stockholm, 1949.

Observations in Östergötland in 1949 showed that rape in various districts there was attacked by the Cecidomyiid, *Dasyneura brassicae* (Winn.), which had not previously been known to occur so far to the north, and the weevil, *Ceuthorrhynchus quadridens* (Panz.), which was known from the area but had not previously proved of economic importance.

Ahlberg (O.). **Nytt skadedjur på lin.** [A new Pest of Flax.]—*Växtskyddsnotiser* 1949 no. 3 pp. 14–15. Stockholm, 1949.

Larvae found injuring the seed capsules of flax at Visby, Sweden, in the summer of 1949 were identified as *Phalonia epilinana* (Zell.), a Tortricid that was not previously known to occur in that country, though it is a common pest of flax in other parts of Europe.

Büttiker (W.). **Flugzeugbestäubung mit Gesarol gegen den Maikäfer und ihre Auswirkung auf die Vogelwelt.** [Aeroplane Dusting with Gesarol against *Melolontha melolontha* and its Effect on Birds.]—*Vögel d. Heimat* **18** no. 10–11 pp. 169–176, 2 pls., 6 refs. Aarau, 1948. (With Summaries in English and French.)

Following preliminary experiments in 1944–47, in which DDT proved effective against adults of *Melolontha melolontha* (L.) (*vulgaris* F.), about 100 acres of mixed woodland in central Switzerland was dusted from the air early in May 1948 with nearly 4,100 lb. Gesarol (containing 5 per cent. DDT). The effect on *M. melolontha* was prolonged, and dead individuals were found for ten days. Particular attention was given to the effects of the dust on the bird life of the area. For this purpose, ten nesting-boxes were set up, and some of them were equipped with an electrical device that registered the number of times the birds entered and left the boxes during the day. There was no significant change either on or after the day when the dusting took place, and other birds of numerous species nesting under natural conditions were also unaffected. Observations on fledglings showed that the quantities of DDT consumed with the food were well below the toxic level.

Waloff (N.), Norris (M. J.) (Mrs. O. W. Richards) & Broadhead (Mrs. E. C.). **Fecundity and Longevity of *Ephestia elutella* Hübner (Lep. Phycitidae).**—*Trans. R. ent. Soc. Lond.* **99** pt. 6 pp. 245–267, 6 graphs, 12 refs. London, 1948.

The following is largely the authors' summary of the observations described, which were carried out to provide data for population studies on *Ephestia*

elutella (Hb.) on wheat in a London granary that have already been noticed [*R.A.E.*, A **36** 210]. Moths mostly originating from the granary were kept for studies on oviposition and survival in the laboratory at 25°C. [77°F.] and 70 per cent. relative humidity, in an untreated outhouse, or in the warehouse, and larvae were reared on wheat at different temperatures in the laboratory and on different foods in the outhouse.

Fecundity (number of eggs laid) and the period of adult survival of the females of *E. elutella* are both functions of their weight on emergence. Heavier moths developed from larvae reared at 17 or 21°C. [62·6 or 69·8°F.] and 70 per cent. relative humidity than at 25°C. and their potential fecundity (number of eggs and egg rudiments produced in the ovaries) was greater. Fecundity increases with temperature, and the survival period simultaneously decreases ; the effect of temperature is thus twofold, and opposing processes are operating. Temperature during the pupal period alone has no marked effect on the number of egg rudiments present in the newly emerged female. The fecundity of the moths is slightly increased by providing them with drinking water. Unfertilised females resorbed 40 per cent. and fertilised females 17 per cent. of their egg rudiments. The increased survival of the unfertilised females may be at least partly due to the greater resorption. Females that developed from larvae in which diapause was shortened by transferring them from outdoor conditions to 25°C. and 70 per cent. relative humidity in February tended to be heavier than those emerging after the normal period of 9–10 months of quiescence. Correspondingly, their fecundity was greater. It is suggested that this is due to less utilisation of the reserve material of the larvae. Similarly, the number of ovarial rudiments in the newly emerged females of the second (non-diapausing) generation was greater than that of the first (diapausing) generation of moths. The number of eggs actually laid by the second-generation moths was, however, lower. This is probably due to the direct inactivating effect of low temperatures. It is also suggested that there is a tendency to sterility in the males at low temperatures. The weights of the moths and the number of their ovarial rudiments at emergence were dependent on the larval diet. Roughly, there was an increase of 24 rudiments per mg. of weight of moth, irrespective of larval diet. There was a corresponding increase in the number of eggs laid and in survival. Most of the eggs were laid in the first 3–4 days after emergence ; the females begin to lay within 24 hours of pairing. The choice of oviposition sites is discussed.

HILLE RIS LAMBERS (D.). **Bladluisproblemen.** [Aphid Problems.]—*Meded. ned. alg. Keuringsdienst Landbouwz.* **8** no. 4 pp. 26–29, 5 figs. Wageningen, 1951.

Myzus persicae (Sulz.) is the most important of the Aphids that transmit virus diseases of potato in Holland. Its annual cycle of development is described, and various possible methods of controlling it on crops grown for seed potatoes, so as to obtain virus-free stocks, are discussed. Recent investigations with adhesive traps in England have shown a high correlation between the numbers of alates of *M. persicae* taken per season and the spread of leaf-roll [*R.A.E.*, A **38** 295], so that it has now become possible to forecast the quality of seed stocks. It is hoped to improve the method by finding a similar correlation between virus spread and Aphid numbers per day and thus forecast in any year the latest date for harvesting virus-free seed potatoes. Investigations to this end have been begun in various parts of Holland, and since Moericke of Bonn has found that the Aphids are attracted by the colour yellow, the adhesive traps have been replaced by shallow dishes containing water or formaldehyde solution, the bottom of the dishes being yellow in colour.

The winter eggs of *M. persicae* are laid on peach and related plants, but the only one in Holland on which the fundatrices have hitherto been known to develop and give rise to further generations has been peach [*cf.* **34** 367]. It has recently been found, however, that this also occurs in certain circumstances on *Prunus serotina*. This shrub or tree is being much used in forestry as a soil improver and has been planted in great numbers in areas in Holland from which peach is almost absent. Birds are attracted to the fruits and spread the plant still further. The complete eradication of peach from such areas is therefore useless as a means of controlling infestation by *M. persicae*.

KARABAĞ (T.). **Ankara vilâyeti dahilinde mevcut çekirgelerin ekolojik, coğrafi ve sistematik durumları üzerinde araştırmalar.** [Investigations on the Ecology, Distribution and Classification of the Orthoptera of the District of Ankara.]—*Ankara Univ. Ziraat Fak. Yayın.* no. 4, [3+]121 pp., 124 figs., refs. Ankara, 1949. (With a Summary in German.)

The investigations described in this work were begun in 1940 in view of the scanty information available in the literature on the Orthoptera of Turkey. The author gives a chronological survey of outbreaks of locusts and grasshoppers there from 1833, describes three sample areas of different ecological types in the district of Ankara that were investigated and gives lists of the species of Orthoptera found in them, with notes on their morphology and the frequency and feeding habits of many of them. In all, they comprised some 80 species. This is followed by a systematic list of these and other Orthoptera recorded from the district in the literature, showing their synonymy and seasonal occurrence, and numerous keys to the species.

WENZL (H.). **Raps-Kräuselkrankheit in Österreich.** [Crinkle Disease of Rape in Austria.]—*Pflanzenschutzberichte* **2** pt. 11–12 pp. 183–185, 1 fig., 3 refs. Vienna, 1948. (With a Summary in English.)

About 2 per cent. of rape plants in a field near Krems, Lower Austria, were found in April 1948 to be suffering from a crinkle disease, the symptoms of which are described. They resembled closely those of the virus disease of rape and other crucifers recorded by Kaufmann from north-western Germany [*cf. R.A.E.*, A **24** 613], and it is thought that the same or a closely related virus was the cause. The diseased plants occurred irregularly or in small groups throughout the field. In Germany, Kaufmann found that the virus was transmitted by *Lygus pratensis* (L.) [*cf. loc. cit.*] and also by the Aphids, *Myzus* (*Neomyzus*) *circumflexus* (Buckt.), *Macrosiphum* (*Aulacorthum*) *solani* (Kalt.), *Myzus* (*Myzodes*) *persicae* (Sulz.) and possibly *Brevicoryne* (*Brachycolus*) *brassicae* (L.), and this would explain the natural spread of the infection.

PAPERS NOTICED BY TITLE ONLY.

CARTER (R. H.). **Report on DDT in Foods** [methods of determination on apples].—*J. Ass. off. agric. Chem.* **31** no. 2 pp. 355–358, 4 refs. Washington, D.C., 1948.

FLECK (E. E.). **Report on DDT** [methods of determination].—*J. Ass. off. agric. Chem.* **31** no. 2 pp. 368–372, 9 refs. Washington, D.C., 1948.

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